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CHAPTER 3

Trends in Total Capital Formation, 1869–1955

Rate of Growth in Gross and in Net Capital Formation

THIS chapter deals with the long-term trends in total capital formation—that is, in total current additions to the country's reproducible capital. The relevant data are summarized in Table 2.

As measured in this table, capital formation comprises: construction of all types including residential, but excluding repairs and maintenance; flow to domestic users of producers' durable goods—machinery and other equipment but excluding small tools; net changes in inventories of business and, insofar as data permit, of governments; and net changes in claims against foreign countries. Neither consumers' durable commodities nor changes in inventories within households are included. In gross capital formation, the annual volumes of construction and of the flow of producers' durables are taken before deduction of current consumption of fixed durable capital; in net capital formation, the latter is deducted. Capital formation, gross or net, is a component of national product, gross or net. It represents withdrawals from aggregate product for the purpose of adding to the stock of material capital within the country or to claims against other countries, and it is thus identical with national savings, gross or net.

Since our primary interest is in the volume of capital formation unaffected by changes in price levels, the totals in Table 2 are in constant prices. And to eliminate not only the shorter business cycles but also the long swings discussed in Chapter 2, the series were averaged for periods of at least twenty years. The only exception is the average

TABLE 2

RATE OF GROWTH IN CAPITAL FORMATION, GROSS AND NET, 1929 PRICES, 1869–1955
(amounts in billions of dollars, averages per year)

Periods	Gross Capital Formation (1)	Capital Consumption (2)	Net Capital Formation (3)	Ratio of (2) to (1) (4)	Capital Retirements (5)	Ratio of (5) to (1) (6)
			VOLUMES			
Total						
1. 1869–1888	3.48	1.46	2.02	0.42	0.87	0.25
2. 1889–1908	8.68	4.03	4.65	0.46	2.18	0.25
3. 1909–1928	15.5	8.39	7.12	0.54	4.72	0.30
4. 1929–1955	22.7	17.3	5.44	0.76	14.5	0.64
5. 1946–1955	33.0	25.1	7.88	0.76	21.4	0.65
Total, excluding military						
3a. 1909–1928	15.0	8.0	7.00	0.53	4.33	0.29
4a. 1929–1955	19.1	14.4	4.69	0.75	11.6	0.61
5a. 1946–1955	29.7	19.3	10.5	0.65	15.6	0.52
			PERCENTAGE RATE OF GROWTH PER DECADE, TOTAL PERIOD			
Total						
6. Line 1 to line 4	34.4	47.6	16.9		55.8	
7. Line 1 to line 5	36.7	48.4	20.8		56.1	
Total, excluding military						
6a. Line 1 to line 4a	30.8	43.5	14.2		50.5	
7a. Line 1 to line 5a	34.7	43.1	25.7		49.4	
			PERCENTAGE RATE OF GROWTH PER DECADE, SUBPERIODS			
Total						
8. Line 1 to line 2	58.0	66.1	51.8		58.7	
9. Line 2 to line 3	33.7	44.3	23.8		47.1	
10. Line 3 to line 4	17.7	36.1	−10.8		61.1	
11. Line 3 to line 5	26.6	40.9	3.2		60.4	
Total, excluding military						
8. Line 1 to line 2	58.0	66.1	51.8		58.7	
9a. Line 2 to line 3a	31.5	40.9	22.7		40.9	
10a. Line 3a to line 4a	10.9	28.6	−15.7		52.2	
11a. Line 3a to line 5a	23.8	31.6	13.3		49.1	

SOURCE: Lines 1–5: Cols. 1, 2, and 3 calculated from Table R-29; col. 5 calculated by procedure described in the text.
Lines 3a–5a: Lines 3–5 minus military, calculated from Table R-7.

for the decade after World War II, shown to reveal the recent level of peacetime capital formation in the country. The averages in Table 2 are arithmetic means, although the underlying secular trends would have been more accurately portrayed by geometric means. But we felt that the additive relation between net capital formation, capital consumption, and gross capital formation retained by using arithmetic instead of geometric means justified the minor error involved.

The findings suggested by Table 2 may now be listed:

1. The annual volume of gross capital formation increased markedly. From 1869–1888 to 1929–1955, it rose to almost seven times its original level; and during the most recent period, 1946–1955, was at a level over ninefold that prevailing during 1869–1888. The average rise per decade over the period was 34 per cent, if we use 1929–1955 as the terminal period; or 37 per cent, if we use the post-World War II years as terminal.

2. Military construction and other military durables swelled the volume of total capital formation in recent decades. For many purposes, it may be better to limit capital formation to peacetype goods. When this is done, the rate of secular growth in gross capital formation is reduced somewhat, but not appreciably: the rise per decade from 1869–1888 to 1929–1955 is 31 per cent; from 1869–1888 to the post-World War II decade, about 35 per cent.

3. The secular rise in capital consumption was greater than that in gross capital formation. The former increased almost elevenfold from 1869–1888 to 1929–1955, if we include military capital; slightly less than ninefold, if we exclude military goods. The rise was even greater from the average for 1869–1888 to that for the post-World War II years. The percentage rate of growth per decade ranged, for the different definitions of the terminal period and including or excluding consumption of military capital, from 43 per cent to somewhat over 48 per cent.

4. With the higher rate of growth in the volume of capital consumption than in gross capital formation, there was a secular rise in the proportion of the former to the latter. The ratio of capital consumption to gross capital formation rose from somewhat over four-tenths in the early decades to over three-quarters (for total capital) or almost two-thirds (for capital excluding military) in the latest period. Correspondingly, the proportion of net capital formation to gross declined from somewhat less than six-tenths to almost a quarter (for total capital) or over one-third (for capital excluding military). To put

it differently, in the earlier decades it took about 1.7 dollars of gross capital formation to yield 1 dollar of net addition to capital stock; in the recent period it took from less than 3 to somewhat over 4 dollars of gross capital formation to yield 1 dollar of net addition to capital stock.

5. The volume of net capital formation also grew significantly, but at a rate lower than that for either gross capital formation or capital consumption. From 1869–1888 to 1929–1955, it rose to over 2.5 times the initial level, and by the post-World War II years had risen to almost 4 times the initial level, for total capital including military. If we exclude military capital, the level in the post-World War II years is more than 5 times as high as that in 1869–1888. But whether for total or peacetype capital, the net capital formation level in 1929–1955 is well below that in 1909–1928; and when we use 1929–1955 as the terminal period, the average rate of growth over the entire period is reduced considerably. The average percentage rate of growth per decade shown in Table 2 thus varies from 14 to almost 26, depending upon the terminal period used; but in either case it is appreciably lower than the rate for gross capital formation, which is over 30 per cent, and that for capital consumption, which is over 40 per cent per decade.

6. When three intervals within the total period are distinguished (lines 8–11), the percentage rate of growth declines—even when we terminate the last interval with the post-World War II years, with their relatively high levels of capital formation and consumption. This retardation in the percentage rate of growth is observed in all three totals, including or excluding military capital. The decline in the rate of growth is most marked for net capital formation, and least marked for capital consumption.

The rest of this chapter is devoted to an attempt to suggest some of the factors that may account for the growth of capital formation over the period. But first it may be useful to discuss the meaning of capital consumption. Little mystery attaches to the meaning of gross capital formation: it is largely a flow of tangible and observable commodities into identifiable channels, and while there are many statistical difficulties in its estimation, the conceptual difficulties are those of scope, i.e., of inclusion and exclusion (for example, whether we should include consumers' durables and military capital) and of valuation (primarily allowance for quality changes). Capital consumption, however, is not a directly observable, but rather an imputed, process; and in

view of the magnitudes involved, it should be clearly defined. Any ambiguity in the meaning of capital consumption, of course, affects the meaning of net capital formation since the latter is the residual after we deduct capital consumption.

The estimate is described briefly here, the details being provided in the notes to the basic reference tables in the appendixes. In calculating capital consumption we assumed a useful life span for the durable capital involved—that reflected in the depreciation charges of business firms or, in the case of residential housing, that reflected by diminution in the market value of a house as it ages. Given these life spans, annual consumption is approximated either on a straight-line principle or by some simple curve suggested by market experience, the values being converted from original cost to a 1929 price basis or to a current replacement cost basis.[1] But what do these life spans mean? What is the meaning of the continuous reduction in the value of a structure or of a machine from 100 per cent of its value to zero?

An approximate answer to the question would be that the reduction is intended to reflect the loss in earning power: in the case of business capital, the loss associated largely with obsolescence because of technical progress; in the case of residential housing, the loss associated perhaps more with changes in taste, neighborhood, and other elements determining desirability. The essential physical productive power of the capital good may remain unaffected for quite a number of years after its installation or construction; with proper repairs and maintenance (which are assumed but not included in depreciation charges), the machine or the house is as good as new for a number of years—in

[1] This is not an accurate description. In fact, for our capital consumption series for the years since 1929, we accept the Department of Commerce estimates of business capital consumption, including accidental damage and charges to current account, and add to them estimates of depletion, and of capital consumption of nonfarm residential construction and government construction. The components (except nonfarm residential construction) are then carried back by totals derived from the application of the assumption of a constant life span and of straight-line allocation. But the resulting estimates, despite the use of Department of Commerce totals for recent years, approximate for long periods the levels that would be derived on the basis of the assumed life spans. For example, for 1929–1955, total capital consumption (in 1929 prices) for producers' durables (excluding military), the component for which the comparison can be made most directly, was $178 billion in the series incorporating the Department of Commerce totals, $173 billion in the series based on 13-year life applied to gross producers' durables (including the nonmilitary equipment going to governments). Thus for long periods, the description in the text is roughly true; and there is essential statistical comparability between the capital consumption estimates in column 2 and the capital retirements estimates in column 5.

fact may be somewhat better after initial adjustments and "settling." But with the passage of time, new machines become available, which, per dollar in constant prices, can produce at lower costs; or new types of houses in new neighborhoods emerge, which, again per dollar in constant prices, are more desirable—in the sense of suiting better the housing needs of a given economic or social group. A business firm must allow for the effects of progress-induced obsolescence on its earning power if it is to compete in the long run—or, more generally, if it is to maintain the value of its capital. A house owner must likewise allow for the erosive effect of changes in tastes, neighborhoods, and so forth on the value of his house once built and unmodifiable without further capital expenditures. Simple calculation would demonstrate that, all other conditions being equal, it would pay an entrepreneur to use the older machines at lower rates of capacity, and purchase new ones (to be operated at maximum rates), even though he could still produce the same volume of goods without increased costs (but *not* without foregoing the lower costs possible with the new machines); and that it would pay a house owner to trade the old house for a new one long before the physical deterioration of the former reduced its value to a level close to zero.[2]

To the extent that it represents obsolescence, capital consumption does not signify reduction in the absolute level of productive capacity, nor an increase in absolute cost per unit, but rather the opportunity cost of *not* utilizing the more efficient newer capital items. Insofar as this is true, net capital formation acquires a highly specific meaning: it is net in the sense of being over and above not merely replacement of productive capacity but over and above the stock of old capital built up to the productive capacity which it could have in terms of *current* efficiency of a dollar's worth of capital goods. Zero net capital formation does not, therefore, mean failure to increase the productive capacity of the capital stock. It only means limiting the increase to the sum represented by the product of the annual rate of secular obsolescence and the already existing capital stock.

[2] I have discussed this problem on different occasions, originally in connection with the acceleration principle, in *Economic Essays in Honor of Wesley Clair Mitchell* (New York, Columbia University Press, 1935), particularly pp. 228–248, reprinted in my *Economic Change: Selected Essays in Business Cycles, National Income, and Economic Growth* (New York, Norton, 1952), pp. 66–85; and most recently in a comment on Edward F. Denison's paper in *Problems of Capital Formation: Concepts, Measurement, and Controlling Factors,* Vol. 19, Studies in Income and Wealth (Princeton for NBER, 1957), pp. 271–280.

Short of detailed technical studies of specific capital goods, it would be impossible to measure the relative weight in capital consumption of such obsolescence, as distinct from the physical deterioration which eventually does come about. And increasing obsolescence would lead to retirement of a capital good—since, if economic conditions do not warrant its use, the cost of retaining it, no matter how slight, is still a cost. A rather speculative estimate of the volume of retirements, as distinct from capital consumption, is provided in column 5 of Table 2. Durable goods are assigned the life span implicit in the capital consumption figures, but they are "retired" only at the very end of their life. We make no deduction in its value while a capital item still has any useful life; but its full value is deducted at the end, on the presumption that with completion of its useful life the item is retired and is no longer available as a productive tool.

The estimate is quite tentative because it depends heavily upon an estimate of total useful life. But the order of magnitude it suggests is not without interest. Capital retirements averaged about 0.5 to 0.6 of total capital consumption, until the more recent periods—largely because they reflect capital formation in the more distant past, while capital consumption reflects the more recent levels of capital formation. With a generally upward trend in the volume of capital formation, retirements will be consistently lower than capital consumption—the difference being largely a function of the rate of secular rise in the volume of capital formation. Additions to capital stock, net of retirements but gross of depreciation on stock still in use, averaged, in the early periods, about three-quarters of gross capital formation, retirements averaging about a quarter. It took about one and one-third dollars of gross capital formation to provide a dollar's addition to capital stock net of retirements, but gross of accumulated depreciation on capital items still in use.

The relation changed drastically in recent decades—a reflection primarily of the sharp decline in the rate of growth of gross capital formation, and partly of the emergence of military capital for which we equated current consumption and retirement. Retirements rose to between eight- and nine-tenths of total capital consumption, or between one-half and two-thirds of gross capital formation. Hence, the trend in additions to capital stock, net of retirements and gross of other current depreciation charges, resembles the trend in net capital formation in column 3, showing a sharp decline in the rate of growth.

Two corollaries follow. First, in considering how much additional capital is needed to turn out more product, we must take into account not only net capital formation (column 3) but also at least the part that represents the balance of current depreciation over retirements. For the "replacement" of this balance, as well as of the retirements themselves, means an addition to capital capacity—greater power to produce. Second, the totals are obviously interrelated, and not merely in an additive sense. Capital consumption and retirements of today are the gross capital formation volumes of yesterday. Given the depreciation rates—which change slowly and reflect a rough approximation to wear, tear, and particularly obsolescence—current gross capital formation, the most inclusive of the processes in which we are interested, is a sum of *past* gross capital formation in the form of either capital consumption or retirements and net capital formation which presumably looks toward the *future*. It is this combination of past and future that has to be kept in mind in explaining any aspect of capital formation that takes place currently, that is, within any period whose trend we are trying to analyze.

Relation to Growth of Population and Labor Force

In considering why capital formation grew at the rates and in the pattern suggested by Table 2, we may begin with the obvious point that during the period covered the population and labor force of this country also grew. If we accept this growth as a datum, it is easy to argue that the annual volume of capital formation had to increase to meet the demands of the larger number of people who are the direct users of at least some of the capital goods (residential and related construction, in particular) and to equip the larger number of workers with tools of production. Of course, the relation of growth in population and in labor force to capital formation is not that simple: population and labor force can increase without an increase in capital formation, and vice versa. But the least that can be said is that growing numbers of consumers and workers mean both increasing need and increasing productive power, which in turn make more capital formation necessary and feasible; and unless major obstacles bar the way, the growth in population and in labor force will increase the volume of all production, including capital formation.

Another way of expressing the connection between capital formation and the growth in population and in labor force can be suggested.

An increase in population enjoying constant income per capita can induce additions to the stock of houses and related structures without a decline in the yield of capital so embodied, which would otherwise be the effect of an increase in housing capital per head. Growth in labor force can induce enlarged capital stock without a reduction in yield per dollar of capital which, in the absence of technological progress and perhaps even with its advance, would otherwise be the effect of a rise in the ratio of capital to labor. Conversely, growth in population and in labor force unaccompanied by additions to capital stock should raise the yield of capital and stimulate capital formation.

How should we compare growth in population and in labor force with growth in capital formation? The latter represents additions to the already existing stock. We could (1) compare the stock of capital, growing as a result of current capital formation, with the human stock, i.e., total population or labor force; or (2) compare *additions* to capital stock—current capital formation—with additions to the stock of population or labor force. Of the two comparisons the former is to be preferred. The latter involves the artificial assumption that additions to capital stock are necessarily closely related to additions to population and to labor force. We use this assumption for a specific purpose later, but the most relevant comparison between growth in capital and growth in population and in labor force rests on the view that the total stock of capital is a tool in the hands of, and for the service of, the total stock of population and workers.

Table 3 brings together the data needed for this comparison. The net capital stock figure (column 3) is the value, in constant prices, of the accumulated capital formation, net of current depreciation. But there are, in addition, two gross capital stock figures. In one—gross, net of retirements (column 2)—we subtract retirements, but not the accumulated depreciation of stock that is still extant because it is assumed not to have been retired. In the other (column 1), no deduction for capital consumption is made. This series in column 1, unrealistic because it exaggerates the volume of capital goods available at any given time, nevertheless serves the purpose of a kind of upper level.

With these comments, and a note to the effect that the labor force includes all gainful workers, whether or not employed at the time of reporting, we summarize the findings suggested by Table 3.

1. As expected, the stock of capital, both net and gross, grew at high rates. From 1869 to 1955, net capital stock increased to about 16 times its initial level; gross capital stock net of retirements, to 18

TABLE 3

RATE OF GROWTH IN CAPITAL STOCK, GROSS AND NET, 1929 PRICES, IN POPULATION, AND IN LABOR FORCE, 1869–1955

Years [a]	*Total Capital Stock ($ billions)*				*Capital Stock Per Capita ($ thousands)*				*Capital Stock Per Member of Labor Force ($ thousands)*		
	Gross (1)	Net of Capital Retirements (2)	Net of Capital Consumption (3)	Population (millions) (4)	Gross (5)	Net of Capital Retirements (6)	Net of Capital Consumption (7)	Labor Force (millions) (8)	Gross (9)	Net of Capital Retirements (10)	Net of Capital Consumption (11)
				VOLUMES							
Total stock											
1. 1869	45	36	27	40.0	1.12	0.90	0.68	12.8	3.52	2.82	2.11
2. 1879	71	56	42	49.7	1.42	1.12	0.85	17.0	4.16	3.27	2.49
3. 1889	116	89	68	62.5	1.86	1.43	1.09	22.3	5.22	4.01	3.06
4. 1899	190	143	108	75.1	2.53	1.90	1.44	28.5	6.66	5.01	3.79
5. 1909	296	224	165	90.9	3.25	2.47	1.82	37.4	7.90	5.99	4.41
6. 1919	430	323	227	105.9	4.06	3.04	2.15	41.6	10.32	7.75	5.46
7. 1929	607	440	306	122.3	4.96	3.60	2.50	48.4	12.54	9.09	6.33
8. 1939	727	480	319	131.8	5.52	3.64	2.42	52.8	13.77	9.08	6.04
9. 1946	895	547	374	142.0	6.30	3.85	2.63	58.0	15.44	9.43	6.45
10. 1955	1,191	649	442	165.9	7.18	3.91	2.66	65.6	18.15	9.89	6.74

Total stock, excluding military											
7a. 1929	597	437	304	122.3	4.88	3.58	2.49	48.4	12.33	9.04	6.28
9a. 1946	820	501	328	142.0	5.77	3.53	2.31	58.0	14.13	8.63	5.65
10a. 1955	1,085	626	419	165.9	6.54	3.78	2.53	65.6	16.54	9.54	6.39
PERCENTAGE RATE OF GROWTH PER DECADE, TOTAL PERIOD											
1869 to 1955											
11. Total stock	46.4	40.0	38.4	18.0	24.1	18.6	17.3	21.0	21.0	15.7	14.4
11a. Total stock, excluding military	44.8	39.4	37.6	18.0	22.7	18.1	16.6	21.0	19.7	15.2	13.7
1869 to 1929											
12. Total stock	54.3	51.8	49.9	20.5	28.1	26.0	24.4	24.9	23.6	21.5	20.1
12a. Total stock, excluding military	53.9	51.6	49.7	20.5	27.7	25.9	24.3	24.9	23.2	21.4	19.9
PERCENTAGE RATE OF GROWTH PER DECADE, SUBPERIODS											
Total stock											
13. 1869 to 1889	60.8	57.6	58.9	25.1	28.6	26.1	27.0	32.1	21.7	19.3	20.3
14. 1889 to 1909	59.4	58.4	55.7	20.6	32.2	31.3	29.2	29.6	23.0	22.2	20.1
15. 1909 to 1929	43.3	40.1	36.2	16.0	23.5	20.7	17.4	13.8	26.0	23.2	19.8
16. 1929 to 1955	29.6	16.1	15.1	12.4	15.3	3.3	2.4	12.4	15.3	3.3	2.4
Total stock, excluding military											
13. 1869 to 1889	60.8	57.6	58.9	25.1	28.6	26.1	27.0	32.1	21.7	19.3	20.3
14. 1889 to 1909	59.4	58.4	55.7	20.6	32.2	31.3	29.2	29.6	23.0	22.2	20.1
15a. 1909 to 1929	42.1	39.7	35.7	16.0	22.5	20.4	17.0	13.8	24.9	22.8	19.3
16a. 1929 to 1955	25.9	14.8	13.2	12.4	11.9	2.1	0.7	12.4	12.0	2.1	0.7

[a] Mid-year date for absolute volumes.

(Notes on following page)

TABLE 3 (concluded)

SOURCE: The capital stock figures in col. 3 are net of accumulated depreciation. The basic figure is that for 1880, taken from Raymond W. Goldsmith, "The Growth of Reproducible Wealth of the United States of America from 1805 to 1950," *Income and Wealth, Series II* (International Association for Research in Income and Wealth, Cambridge, England, Bowes and Bowes, 1952), Table II, p. 310. It includes reproducible durables (excluding consumer durables), inventories, gold and silver, and the net balance of foreign claims. To derive the series for the other years, we added to or subtracted from the basic 1880 figure our annual estimates of net capital formation.

The gross capital stock figure in col. 1 begins with an estimate of the net capital stock of wealth in 1805, also from Goldsmith's series. This, in terms of the concept mentioned above, amounts to $0.9 billion in 1929 prices. If we assume a ratio of gross stock to net of about 1.67 (corresponding to a long-term ratio of net capital formation to gross of 0.60), the gross stock of capital in 1805 is $1.5 billion. The ratio of net to gross capital formation of 0.6 was based on Table 2; but even a major error in that figure or in the ratio applied to the 1805 figure for net capital stock to derive gross capital stock would have minor effects on the totals beginning in 1869.

Goldsmith's figures yield net capital formation from 1805 to 1880 (derived as first differences in the net stock of capital between the two dates). On the assumption that net capital formation is 0.6 of gross, we can then estimate gross capital formation for 1805–1880. Adding this total to gross capital stock in 1805 yields the gross capital stock in 1880. The ratio of the latter to the net capital stock (Goldsmith's total) is, as should be expected, 1.67. We applied this ratio to our net capital stock total for 1869 to derive the initial estimate of gross capital stock for 1869 in col. 1. With this figure and our estimates of gross capital formation at hand, we derived the figures for later dates by successive addition.

The series on gross capital stock net of retirements (col. 2) was derived along lines similar to those described for gross capital stock in col. 1. The major difference lies in the ratio of net capital formation to gross, in this case gross net of retirements. On the basis of the life spans (13 years for producers' durables and 50 years for construction, the terminal years or decades given half weight) and the earlier levels of construction and producers' durable equipment underlying the capital consumption estimates, we set the ratio at 0.75; which yields a ratio, in the long run, of gross capital stock net of retirements to net capital stock of 1.33. With these ratios set, and with the application of constant life spans, the initial estimate for 1869 in col. 2 was derived and the subsequent totals estimated by successive addition. These calculations were applied to nonmilitary construction and equipment alone; for military we assumed retirements to be equal to consumption.

The population and labor force estimates are the annual series underlying Tables R-37 and R-39.

times; and the somewhat unrealistic capital stock gross of all consumption, to about 26 times its initial level. The exclusion of military capital reduces these rates of growth slightly.

2. If the growth of capital stock were caused by growth in numbers—of total population and of the labor force—and returns to scale were constant, capital per head and per member of the labor force would have remained constant during the period. Instead, we observe a marked growth in capital per person and per member of the labor force. Net capital stock per head rose, over the period as a whole, to

about 4 times its initial level, whether or not we include military capital, i.e., at a rate of about 17 per cent per decade. The rate of growth for gross capital net of retirements per head was slightly higher. That for total gross capital per person was materially higher, but the element of exaggeration must be borne in mind. Since labor force grew at somewhat higher rates than total population, the rate of growth of capital stock per member of the labor force was somewhat lower than that of capital per person. But even its lowest rate of growth per decade, for the period as a whole, was 14 per cent (for net capital stock).

3. The rate of growth declined significantly. This is apparent from the entries in lines 11 and 12, which show the rate of growth for the period as a whole, from 1869 to 1955, and for the period terminating in 1929. In every comparison, the rate of growth for the period including the last twenty-seven years was distinctly below that for the first six decades covered, not only for each total capital stock series, but also for capital stock per person and per member of the labor force.

Retardation in the rate of growth of the aggregates is found also when we study successive wide intervals, not shorter than twenty years, within the period (lines 13–16). Even for gross capital stock, the rate of growth in the third interval (from 1909 to 1929) was significantly lower than in the first two.

4. The retardation in the rate of growth of total capital stock is to some extent accounted for by a decline in the rate of growth of population and of the labor force. The entries in columns 4 and 8 record the familiar and well-established fact that the percentage rate of growth in numbers in the country has been tending downward. Consequently, the retardation in the rate of growth of capital stock per capita and per member of the labor force is not as continuous as that of total stock. The decrease in the rate of growth of stock per capita—whether net, gross excluding retirements, or gross of all consumption—is not evident until after 1909; and for two of the variants of stock per member of the labor force, retardation in the rate of growth does not set in until after 1929. Neither date should be given too much weight. The important finding is that with the exception of net capital stock the supply of capital goods per worker grew at a slightly increasing rate through most of the period, the decline in the rate of growth emerging only in the most recent interval, 1929 to 1955.

5. This last finding is of particular interest. Over some sixty years of the period, capital stock per worker grew at high rates, and except in the case of net capital stock, at slightly rising rates. It is only after the 1920's that the growth of capital per worker declined. And the decline was quite drastic. In the two most realistic series, net capital and gross capital excluding retirements, the level of capital per member of the labor force shows very little growth after 1929. It is true that the period beginning in 1929 includes the Great Depression; but on the other hand, it includes also the expansion years of World War II and a decade of particularly high levels of capital formation following the conclusion of that war. If we view the average in 1929–1955 as an approximation to long-term secular levels, we can hardly escape the conclusion that substantial changes have occurred in the factors that determine capital formation—a point to be explored further as we proceed.

With the data in Table 3 it is possible to allocate the growth in total capital between that part which can be ascribed merely to the increase in population or in the labor force—on the assumption of a constant supply of capital per person or per worker—and that which can be ascribed to the growth in stock per capita or per member of the labor force. The results of the calculations are given in Table 4. We assume that the stock per capita or per member of the labor force remained constant at the 1869 level in the decades that followed, and that the growth in capital stock was due merely to growth in population or labor force. Lines 1 and 1a, covering the total period, show that, under such conditions, the growth in total capital stock would have been only a small fraction of the actual increase. In the case of stock gross of all consumption, the increase in population accounts for between one-eighth and one-seventh of the total addition that occurred. In other words, gross capital formation cumulated over the period would have been only 12 to 14 per cent of its actual volume. The increase in the labor force, under the conditions assumed, would have contributed a somewhat greater increase to gross capital stock—about one-sixth of the increase that occurred. In other words, gross capital formation under these conditions would have been from 16 to 18 per cent of its actual volume. In the case of net stock, the hypothetical contribution of the increase in numbers is somewhat greater—about one-fifth due to the rise in population, and over one-quarter due to the rise in labor force. In the case of gross stock, net of retirements, the percentage contributions are slightly lower.

TABLE 4

ALLOCATION OF RISE IN CAPITAL STOCK BETWEEN RISE IN POPULATION OR LABOR FORCE AND RISE IN CAPITAL STOCK PER UNIT, 1869–1955

PERIODS	PROPORTION OF RISE IN: *Gross Capital Stock Due to Rise in:* Population (1)	Labor Force (2)	*Stock Net of Capital Retirements Due to Rise in:* Population (3)	Labor Force (4)	*Stock Net of Capital Consumption Due to Rise in:* Population (5)	Labor Force (6)
	TOTAL PERIOD					
1869–1955						
1. Total capital stock	0.12	0.16	0.18	0.24	0.20	0.27
1a. Total capital stock, excluding military	0.14	0.18	0.19	0.25	0.22	0.28
	SUBPERIODS, TOTAL CAPITAL STOCK					
2. 1869–1888	0.36	0.47	0.38	0.50	0.37	0.49
3. 1889–1908	0.29	0.44	0.30	0.45	0.32	0.48
4. 1909–1928	0.33	0.28	0.36	0.31	0.40	0.34
5. 1929–1955	0.37	0.37	0.75	0.75	0.80	0.80
Geometric means, lines 2–5	0.34	0.38	0.42	0.48	0.44	0.50
	SUBPERIODS, TOTAL CAPITAL STOCK, EXCLUDING MILITARY					
2. 1869–1888	0.36	0.47	0.38	0.50	0.37	0.49
3. 1889–1908	0.29	0.44	0.30	0.45	0.32	0.48
4a. 1909–1928	0.34	0.29	0.36	0.31	0.41	0.35
5a. 1929–1955	0.44	0.43	0.83	0.82	0.94	0.94
Geometric means, lines 2–5a	0.35	0.40	0.43	0.49	0.46	0.53

SOURCE: Calculated from the data underlying Table 3.

Naturally, the relative contribution of growth in numbers increases as we shorten the period, largely because the weight of the other factor—the increase in stock per capita or per member of the labor force—is cumulated over a shorter period. When we average the results for the four intervals, each covering twenty years or more, the contribution of the increase in numbers to the increase in capital stock ranges from slightly more than one-third to about one-half.

These findings for the intervals, however, are less significant in the

present connection than those for the period as a whole, which indicate quite clearly that the direct arithmetic contribution of increase in numbers to capital formation is quite moderate. It is true that growth of population and of the labor force may have many indirect influences, which are extremely important in explaining the volume and growth of capital formation. For example, the wider division of labor made possible by greater numbers permits specialization, increased productivity, and consequently greater capital formation. But there are better measures of these ramified effects than the growth in numbers. The latter, in itself, has contributed too little directly to capital formation in this country since 1869 to merit much weight in any explanatory hypotheses, and we must turn to some other proximate determinants.

There is, however, one significant exception to this statement. The retardation in the growth of population and of labor force is quite marked. According to columns 4 and 8 of Table 3, the rate of growth of population in 1929–1955 was less than half the rate in 1869–1889; and the retardation in the rate of growth of the labor force is even more striking—the rate in 1929–1955 being somewhat over one-third of that in 1869–1889. Considerable significance could be attributed to such slowing down in the rate of growth of population and of labor force in explaining, if only in part, the retardation in the rate of growth of capital stock, and via the latter, the decline in the rate of growth of capital formation. We must, therefore, bear in mind that, while the increase in numbers alone may be quantitatively of little importance in accounting for the volume and rate of growth of capital formation, the *retardation* in the rate of growth of population and of labor force may be of much greater importance in accounting for the retardation in the rate of growth of gross capital formation, and thus—for reasons that will become clearer in subsequent discussion—for the increased proportion of capital consumption, and for the even greater retardation in the rate of growth of net capital formation.

Rate of Growth in Gross and in Net National Product

If increase in population and labor force contributes little, directly, to the growth of capital stock and to the trends in capital formation, we may find a more important proximate determinant in national product. However, since national product is an aggregate of which capital formation is a component, there is a tautological relation be-

tween the two in the sense that, all other conditions being equal, changes in capital formation mean identical changes in national product. One could argue that to try to explain trends in capital formation on the basis of their relation to trends in national product is like explaining a phenomenon by the phenomenon itself. And yet we feel that there is some meaning in relating capital formation, either directly or in the form of the cumulated stock, to national product. The reason for this "feeling" can be easily stated. Capital formation represents additions to capital stock, which is an important tool in producing national income, output, or product. Capital formation also represents national savings, and is thus a fraction of national product. Hence changes in capital stock will affect national product, and these expected effects may be the *raison d'être* for capital formation and may, therefore, explain it. In turn, changes in national product, the pool from which capital formation is drawn, will naturally affect the magnitude of capital formation. In this two-way relation between capital formation and national product the tautological element is conceptually removed by the introduction of a disparity in the time reference, although in the statistical estimates used here, the time periods are far too long and the data too crude for the lag and lead allowances to be significant and feasible. When capital formation is viewed as additions to tools for turning out national product, the latter is conceived as being produced in the future and capital formation as taking place in the present—governed, as it were, by future product expectations. When capital formation is viewed as the saved portion of national product, the latter is regarded as having been produced in the past, and capital formation as taking place in the present, since it is only realized product that can give rise to real savings. Much of the discussion in the rest of this chapter will deal with these two relations between capital formation and national product.

As a prelude to that discussion, it will be helpful to observe the long-term trends in national product—total, per capita, and per member of the labor force (Table 5). These summary measures, shown in several variants, distinguish gross and net national product, the net differing from the gross in that current capital consumption has been deducted. In Appendixes A and B we present three variants of gross and net national product (or national income, the two terms being used interchangeably here), each variant including identical estimates of gross and net capital formation but each differing in its estimate of flow of goods to consumers. Variant I is based on the original estimates

TABLE 5

RATE OF GROWTH IN NATIONAL PRODUCT, 1929 PRICES, GROSS AND NET, TOTAL, PER CAPITA, AND PER MEMBER OF LABOR FORCE, 1869–1955

Periods	*Gross National Product*			*Net National Product*		
	Total (billions) (1)	Per Capita (2)	Per Member of Labor Force (3)	Total (billions) (4)	Per Capita (5)	Per Member of Labor Force (6)
Variant I						
	VOLUMES, AVERAGES PER YEAR					
Total						
1. 1869–1888	$ 14.4	$ 288	$ 854	$ 13.0	$ 261	$ 772
2. 1889–1908	34.0	454	1,196	30.0	401	1,057
3. 1909–1928	67.3	636	1,594	59.0	558	1,398
4. 1929–1955	115.3	832	2,034	99.0	714	1,746
5. 1946–1955	161.7	1,052	2,605	136.6	888	2,201
Total, excluding military						
3a. 1909–1928	66.7	631	1,582	58.8	556	1,394
4a. 1929–1955	112.1	809	1,977	98.2	708	1,732
5a. 1946–1955	158.4	1,030	2,553	139.2	905	2,242
	PERCENTAGE RATE OF GROWTH PER DECADE, TOTAL PERIOD					
Total						
6. Line 1 to line 4	38.8	18.2	14.6	37.7	17.2	13.7
7. Line 1 to line 5	40.0	19.7	16.8	38.7	18.5	15.7
Total, excluding military						
6a. Line 1 to line 4a	38.2	17.6	14.1	37.5	17.0	13.6
7a. Line 1 to line 5a	39.6	19.3	16.4	39.0	18.8	16.0
	PERCENTAGE RATE OF GROWTH PER DECADE, SUBPERIODS					
Total						
8. Line 1 to line 2	53.8	25.5	18.4	52.1	24.0	17.0
9. Line 2 to line 3	40.7	18.3	15.4	40.1	17.9	15.0
10. Line 3 to line 4	25.8	12.1	10.9	24.7	11.1	9.9
11. Line 3 to line 5	31.5	17.0	16.6	30.0	15.6	15.2
Total, excluding military						
8. Line 1 to line 2	53.8	25.5	18.4	52.1	24.0	17.0
9a. Line 2 to line 3a	40.1	17.9	15.0	39.9	17.7	14.8
10a. Line 3a to line 4a	24.7	11.2	10.0	24.4	10.9	9.7
11a. Line 3a to line 5a	31.0	16.6	16.1	30.9	16.5	16.0

(continued)

TABLE 5 (continued)

Periods	*Gross National Product* Total (billions) (1)	Per Capita (2)	Per Member of Labor Force (3)	*Net National Product* Total (billions) (4)	Per Capita (5)	Per Member of Labor Force (6)
Variant III						
	VOLUMES, AVERAGES PER YEAR					
Total						
12. 1869–1888	$ 14.7	$ 296	$ 874	$ 13.3	$ 267	$ 792
13. 1889–1908	34.9	466	1,226	30.9	412	1,087
14. 1909–1928	69.7	659	1,652	61.4	580	1,456
15. 1929–1955	122.3	882	2,158	106.0	765	1,870
16. 1946–1955	172.3	1,121	2,777	147.2	957	2,372
Total, excluding military						
14a. 1909–1928	69.1	654	1,639	61.2	578	1,451
15a. 1929–1955	119.1	860	2,101	105.2	759	1,855
16a. 1946–1955	169.1	1,099	2,724	149.8	974	2,414
	PERCENTAGE RATE OF GROWTH PER DECADE, TOTAL PERIOD					
Total						
17. Line 12 to line 15	39.6	18.8	15.3	38.6	18.0	14.5
18. Line 12 to line 16	40.7	20.3	17.4	39.6	19.4	16.5
Total, excluding military						
17a. Line 12 to line 15a	39.0	18.3	14.8	38.5	17.9	14.3
18a. Line 12 to line 16a	40.4	20.0	17.1	39.9	19.7	16.7
	PERCENTAGE RATE OF GROWTH PER DECADE, SUBPERIODS					
Total						
19. Line 12 to line 13	53.9	25.5	18.5	52.2	24.2	17.2
20. Line 13 to line 14	41.4	18.9	16.0	41.0	18.6	15.7
21. Line 14 to line 15	27.1	13.3	12.0	26.2	12.5	11.2
22. Line 14 to line 16	32.7	18.1	17.6	31.4	16.9	16.5
Total, excluding military						
19. Line 12 to line 13	53.9	25.5	18.5	52.2	24.2	17.2
20a. Line 13 to line 14a	40.9	18.5	15.6	40.8	18.4	15.5
21a. Line 14a to line 15a	26.1	12.3	11.1	25.9	12.3	11.0
22a. Line 14a to line 16a	32.2	17.6	17.2	32.3	17.7	17.2

(continued)

TABLE 5 (concluded)

Periods	*Gross National Product* Total (billions) (1)	Per Capita (2)	Per Member of Labor Force (3)	*Net National Product* Total (billions) (4)	Per Capita (5)	Per Member of Labor Force (6)
Commerce Concept						
	VOLUMES, AVERAGES PER YEAR					
23. 1869–1888	$ 14.7	$ 296	$ 876	$ 13.4	$ 269	$ 794
24. 1889–1908	35.5	475	1,250	31.5	422	1,110
25. 1909–1928	72.0	681	1,707	63.7	603	1,511
26. 1929–1955	136.8	987	2,414	120.5	870	2,126
27. 1946–1955	190.3	1,237	3,066	165.2	1,074	2,662
	PERCENTAGE RATE OF GROWTH PER DECADE, TOTAL PERIOD					
28. Line 23 to line 26	42.0	20.9	17.3	41.4	20.3	16.8
29. Line 23 to line 27	42.7	22.0	19.0	41.8	21.2	18.3
	PERCENTAGE RATE OF GROWTH PER DECADE, SUBPERIODS					
30. Line 23 to line 24	55.3	26.7	19.5	53.7	25.3	18.3
31. Line 24 to line 25	42.4	19.7	16.8	42.1	19.6	16.7
32. Line 25 to line 26	31.4	17.1	15.9	31.2	16.9	15.6
33. Line 25 to line 27	35.5	20.5	20.1	34.7	19.8	19.4

SOURCE:

Columns 1 and 4

Lines 1–3 and 12–14. Geometric means of successive decade averages in Table R-12.
Lines 4 and 15. Weighted geometric means of decade averages for 1929–1938 and 1939–1948 (from Table R-12) and of the average for 1949–1955 (from Table R-2).
Lines 5 and 16. From Table R-2 (arithmetic means of annual estimates).
Lines 3a–5a and 14a–16a. For military, see notes to Table 2.
Lines 23–27. Average value of gross national product is given for 1929–1938 and later years in Table A-6, col. 2 and extrapolated for earlier years by applying to Variant III the ratio of the Commerce series to Variant III in 1929–1938, and assuming a 0.8 per decade decline in the ratio (as suggested by the movement of the ratio since 1929 in Table A-3). The net national product series is calculated by deducting from the gross national product estimates the difference between cols. 1 and 4, lines 1–5.

Columns 2, 3, 5, and 6

For estimates of population and labor force see notes to Table 3. The decade averages of national product were divided by the decade averages of population and of labor force, and then geometric means of the decade averages of per-capita or per-worker product were calculated for the longer periods in the same fashion as for total national product.

derived by the income-payments method in *National Income and Its Composition, 1919–1938.*[3] Services (and hence total flow of goods to consumers) are approximated by subtracting from national income independently derived estimates of cost of commodities to consumers and of net capital formation. Variant I is extrapolated forward from the 1930's by the appropriate items in the national income accounts of the Department of Commerce. Variant II retains all the commodity flow series of Variant I, but the services component is measured directly, not as a residual. Variant III is based upon the commodity flow and services estimates of the Department of Commerce for the years beginning with 1929, but only those that reflect the concepts underlying Variants I and II. These components of flow of goods to consumers are then extrapolated back to 1919 by the commodity components of Variant I and the services component of Variant II.[4]

Table 5 shows Variants I and III, but to reduce detail, Variant II, which is fairly close to I and III, is omitted. Conceptually all three variants are identical: they are intended to exclude the intermediate product of government activities. They differ only in respect to the estimating procedures. A more important feature of Table 5 is the inclusion of measures for another concept of national product—that used presently by the Department of Commerce. Its chief difference from Variants I and III (and II) lies in the treatment of all government expenditures on commodities and services as final product, and hence the inclusion of those expenditures in national product along with private capital formation and flow of goods to ultimate consumers.

This profusion of variants of national product may be embarrassing, and it certainly does not make for easy discussion and understanding. The retention of these variants and different concepts is not due to a capricious desire to befuddle the unwary reader, but rather serves a purpose. Use of Variants I and III is warranted because it indicates that, even for one definition of national product, justifiable differences in statistical procedure may result in different rates and patterns of growth. Use of the Commerce national product total serves as a reminder of the important differences in judgment of what constitutes net or gross output. It shows that these differences inevitably mean different levels and patterns of long-term trends in the volume of output and, for that matter, of capital. In the attempt to arrive at some ac-

[3] Simon Kuznets, assisted by Lillian Epstein and Elizabeth Jenks (New York, NBER, 1941).

[4] For more detailed discussion and comparison see Appendix A.

ceptable record of long-term trends in such aggregative totals as national income or capital it is important to bear in mind the possible effects of differences in concept and statistical procedures, lest we assign too much weight to the results of a specific conceptual or statistical decision.

With these cautions in mind, we can now list the major findings suggested by Table 5 on rate of growth of national product.

1. For the period as a whole—from the first two decades, 1869–1888, to either the last long period, 1929–1955, or to the post-World War II years—the rise in national product has been impressive. From 1869–1888 to 1946–1955 the volume rose to ten or more times its initial level. The rate of growth per decade ranges from 37.5 to almost 43 per cent—depending upon the terminal period chosen, the inclusion or exclusion of military items (in this case only military capital formation), the deduction or inclusion of capital consumption, and the concept followed. The differences in statistical procedure and even in scope have relatively little effect on the average rate of growth over the period as a whole.

2. Much of this impressive growth in national product can be directly associated with growth in population and in labor force. For product per capita and per member of the labor force, the average percentage rate of increase was from about one-third to one-half of that for the total: that in product per capita ranged from 17 to 22 per cent per decade; that in product per member of the labor force, from somewhat under 14 to 19 per cent. But the cumulation of such rates over more than six or seven decades produces a marked rise in product per capita or per worker. Thus, net national product per capita in 1929–1955 was about three times its 1869–1888 level; and net national product per worker grew almost as much. A tripling of the average standard of living per head in slightly over six decades—and this is essentially what is implied—is an extraordinary performance, in that there are few equally long historical periods when it could have occurred, and there are almost no countries in which such a rise occurred from levels that, in the initial period, were already so high.

3. In observing the rates of growth for successive intervals within the period, the last interval terminating in 1929–1955 or 1946–1955, we find that for total product, whether gross or net and whatever the variant, the rate of growth declined. Invariably, the average level for the post-World War II decade, 1946–1955, reflects a higher rate of growth per decade from 1909–1928 than that for the longer period

1929–1955. But even if we use this more favorable showing of the post-World War II decade, the rate of growth per decade is lower than in the interval from 1889–1908 to 1909–1928. And there is room for argument as to whether the average for 1946–1955 represents a long-term secular level, rather than a position above it reflecting some transiently favorable conditions of the immediate post-World War II years. This problem of interpretation of the secular significance of the recent decade requires careful examination, best undertaken at a later stage in the analysis.

4. As might have been expected from our earlier discussion, much of the retardation in the rate of growth of total product can be directly associated with retardation in the rate of growth of population and of labor force. As a consequence, for product per capita or per member of the labor force, no sweeping conclusion concerning retardation in the rate of growth can be made; and the evidence must be summarized with careful attention to detail.

5. If 1929–1955 is taken as the terminal period, we find a consistent decline in the rate of growth of product per capita and per member of the labor force—for Variants I and III and the Commerce concept, gross and net product, including and excluding military. The only qualification is that for the Commerce concept, in which the expansion of government activities is tantamount to an increase in final product, the decline from the rate of growth of product per capita and per worker for the interval 1889–1908 to 1909–1928 to that for the interval 1909–1928 to 1929–1955 is rather moderate (see lines 31 and 32).

6. If we use the high level of the 1946–1955 decade as the terminal datum, the results change. The decline in the rate of growth of product per capita and per worker between the first and the second intervals is not affected, of course. But the retardation over the interval between 1909–1928 and 1946–1955 (i.e., when we skip the intervening depression and war years) disappears. In other words, from the secular level in 1909–1928 to the level in 1946–1955, treated here as secular, the rate of growth in product per capita and per worker is almost as high as, or higher than, the rate of growth from 1889–1908 to 1909–1928.

7. The conclusions suggested just above may be restated somewhat more vividly. If we assume that the depression of the 1930's is canceled by the expansions that preceded and followed it, and regard the longer-term averages as truly representative secular levels, we find retardation in the rate of growth not only of total income, but also of product per head and per worker. If, however, we omit the depres-

sion and the war years, and regard the 1946–1955 averages as secular levels, there is no clear case for retardation in the rate of growth of product per capita or per worker.

The emphasis above on ascertaining the existence or absence of retardation in the secular rate of growth may at first seem puzzling. But it should be no more puzzling than our interest in the absolute level of income or in its percentage rate of growth. Given an initial level of product or income, it makes a difference whether, in the process of secular growth, the average rate over a long period is 5 or 15 per cent per decade: a higher rate not only means much greater volume with the passage of time, but, in the present connection, it may also be associated with the volume of capital formation, and may in turn have an effect on it. But given an average rate of growth per decade over a long period, we must also know whether this is an average of relatively constant rates—about the same at the beginning and at the end of the period—or whether it is an average of rates that systematically decline or rise. For consistent retardation or acceleration is a signal that some process is continuously at work modifying the factors that determine the average rate of growth; and this calls for an investigation of these factors to see whether the consistency observed in the past is likely to continue into the future.

Relation of Capital to Output

If capital formation is necessary to maintain or increase the stock of capital goods required to produce desired output, the possibilities of explaining the level of and trend in capital formation lie in a comparison of capital stock with output—on either an aggregative or component basis. The line of reasoning, following the Harrod-Domar model, can be briefly stated. Assume that technological and other requirements call for a given ratio of capital stock to desired annual output, say the ratio of 3 to 1. Then if population and its desired level of per capita output both increase, the required rate of growth of total output or national product (i.e., increased population multiplied by increased per capita product) is, let us say, x per cent per year. To maintain the required ratio of capital to output of 3 to 1 with the x per cent of growth of output calls for a growth in capital stock equal to $3x$ per cent of annual aggregate output. Hence, under the assumptions just stated, capital formation—additions to the stock of capital—equals $3x$ per cent of national product (which determines the level of the

capital formation proportion to national product), and the rate of percentage growth in capital stock equals the rate of growth in national product. In turn, the percentage rate of growth of capital stock, if observed over successive periods, will reveal the rate of growth of capital formation, i.e., of additions to capital stock. If we can either explain or assume the level and rate of growth of population and of product per capita, we can, given a constant (or changing) capital-output ratio, derive the level and rate of growth of capital formation.

While this is obviously a highly oversimplified view, it is sufficient to indicate the broad rationale for our interest in the capital-output ratio as a measure that may advance our understanding of the factors that determine the volume of and rate of growth in capital formation. But in trying to apply the schema to the estimates, we are immediately confronted with specific questions. Should we use gross capital stock or stock adjusted for actual retirements as the numerator of the ratio we wish to study? Or should we take capital stock net of all accumulated depreciation? What measure of aggregate output should we use as the denominator—national product, as we define it or as the Department of Commerce defines it, and should it be gross or net of depreciation? These specific questions have wider implications that bear upon the whole meaning and usefulness of the capital-output ratios in the analysis; but these implications can be discussed more effectively after studying the statistical value of the ratios. For the present therefore, the purpose of these questions is merely to indicate the reason for the several sets of capital-output ratios given in Table 6.

In one set, gross capital stock is related to gross national product, Variant I, and the Department of Commerce concept. We shall henceforth omit Variant III to reduce detail; besides, Variant I and the Commerce totals show the widest differences, whereas those among our three variants do not affect the findings significantly. In another set, gross capital stock, net of retirements, is related to net national product. It might have been more justifiable to relate it to gross national product, net of retirements, but the resulting ratios would have differed only slightly from those shown. In the third set of ratios net capital stock is related to net national product.

The capital-output ratios are calculated for the successive decades, the numerator being the geometric mean of the capital stock at the beginning and end of the decade, and the denominator, the annual average of national product during that decade. Both numerator and denominator are in constant prices, to avoid the effect of the greater

TABLE 6

RATIO OF CAPITAL STOCK TO AVERAGE ANNUAL NATIONAL PRODUCT PER DECADE, BASED ON VOLUMES IN 1929 PRICES, 1869–1955

Intervals for Capital Stock, Geometric Mean of Terminal Years	*Periods for National Product, Annual Averages*	*Ratio of Gross Capital Stock to Gross National Product*		*Ratio of Gross Capital Stock Net of Retirements to Net National Product*		*Ratio of Net Capital Stock to Net National Product*	
		Variant I (1)	Commerce Concept (2)	Variant I (3)	Commerce Concept (4)	Variant I (5)	Commerce Concept (6)
Total stock and product							
1. 1869 & 1879	1869–1878	5.4	5.3	4.7	4.6	3.6	3.5
2. 1879 & 1889	1879–1888	4.6	4.5	4.0	3.8	3.0	2.9
3. 1889 & 1899	1889–1898	5.4	5.2	4.7	4.5	3.6	3.4
4. 1899 & 1909	1899–1908	5.6	5.3	4.8	4.5	3.5	3.4
5. 1909 & 1919	1909–1918	6.2	5.9	5.4	5.0	3.9	3.6
6. 1919 & 1929	1919–1928	6.5	6.0	5.4	5.0	3.8	3.5
7. 1929 & 1939	1929–1938	8.1	7.3	6.4	5.7	4.4	3.9
8. 1939 & 1949	1939–1948	6.8	5.4	5.0	3.8	3.3	2.5
9. 1946 & 1955	1946–1955	6.4	5.4	4.4	3.6	3.0	2.5
Total, excluding military							
5a. 1909 & 1919	1909–1918	6.2		5.4		3.8	
6a. 1919 & 1929	1919–1928	6.4		5.3		3.7	

7a. 1929 & 1939	1929–1938	7.9		6.4		4.3	
8a. 1939 & 1949	1939–1948	6.9		5.0		3.3	
9a. 1946 & 1955	1946–1955	6.0		4.0		2.7	
Longer Intervals (arithmetic means)							
Total stock and product							
10. Lines 1 & 2	1869–1888	5.0	4.9	4.4	4.2	3.3	3.2
11. Lines 3 & 4	1889–1908	5.5	5.2	4.8	4.5	3.6	3.4
12. Lines 5 & 6	1909–1928	6.4	6.0	5.4	5.0	3.8	3.6
13. See note a	1929–1955	7.2	6.1	5.3	4.5	3.6	3.0
14. See note b	1939–1955	6.6	5.4	4.7	3.7	3.1	2.5
Total, excluding military							
10. Lines 1 & 2	1869–1888	5.0		4.4		3.3	
11. Lines 3 & 4	1889–1908	5.5		4.8		3.6	
12a. Lines 5a & 6a	1909–1928	6.3		5.4		3.8	
13a. See note a	1929–1955	7.0		5.3		3.5	
14a. See note b	1939–1955	6.5		4.6		3.1	

[a] Weighted average of line 7 (or 7a), 8 (or 8a), and geometric mean of 1949 and 1955.

[b] Weighted average of line 8 (or 8a) and geometric mean of 1949 and 1955.

SOURCE: The capital stock series are from Table 3; the national product series are those underlying Table 5.

sensitivity of price movements of current output than of reported valuation of capital stock. The decadal ratios thus obtained are averaged over longer periods to convey some idea of the long-term trends. The results of these calculations are now summarized.

1. The ratios of net capital stock to net national product range from 2.5 to close to 4 (disregarding the levels over 4 in the decade of the 1930's when output and rates of utilization of capital were distinctly below the secular levels). The capital-output ratios are somewhat higher if we take capital stock net of retirements but gross of depreciation on assets still in existence: they range from slightly over 3.5 to almost 5.5, again excluding the abnormal decade of the 1930's. Naturally, if we deal with capital stock gross of all consumption, the ratios tend to be still higher, even though we use gross national product rather than net as the denominator: they range from 4.5 to almost 7.

2. Of greatest interest here are the movements in the capital-output ratios over time. Have they been constant in the long run, suggesting the existence of some deep-seated and persistent forces? Or if there have been marked trends, what have been the direction, timing, and magnitude of these trends?

In answering these questions, the longer period averages are of most bearing. Over periods as short as decades, the effects of business cycles and similar short-term disturbances may still be marked—on the numerator and perhaps more so on the denominator. If, then, we concentrate attention on lines 10–14, we find that the net capital stock ratios tended to rise from the first long subperiod, 1869–1888, to the third, 1909–1928, and then declined, regardless of whether the terminal period is 1929–1955, or 1939–1955, that is, omitting the decade of the 1930's. Two aspects of this long rise and subsequent decline in the net capital-output ratios should be noted. First, this movement is observed in both variants. Second, although the capital-output ratio for the last subperiod, 1929–1955, is bolstered by the abnormally low level of the denominator in the 1930's, it is still lower than that for 1909–1928.

An almost identical pattern is observed for the ratios of gross capital, excluding retirements, to net national product: the same distinct rise from 1869–1888 to 1909–1928, the same distinct decline to 1929–1955, even more distinct if we limit the last subperiod to 1939–1955. The somewhat unrealistic gross capital-gross national product ratios, however, reveal a different long-term pattern. These ratios continue to rise throughout, if we use 1929–1955 as the last subperiod. But even

here, the rise from 1909–1928 to 1929–1955 is negligible when the "grosser" Commerce concept product total is used as the denominator; and it disappears or becomes negligible for both variants when we omit the depressed 1930's and use 1939–1955 as the last subperiod.

3. This reversal in the long-term movement of the capital-output ratios is but a result of differential changes in the rate of growth of capital stock and of national product, commented upon in connection with Tables 3 and 5. The rate of growth of both capital stock and national product declined over the long period beginning with 1869. But until the end of the 1920's the growth of capital stock more than kept pace with the growth of national product, whereas in recent decades the sharp decline in the proportional volume of capital formation reduced the growth of capital stock far more than it did the long-term level of national product. Both numerator and denominator were still rising during the last subperiod, as they were during the earlier ones; but the retardation in the growth of capital was much greater than that in the growth of product.

The measures in Table 6 are average ratios, relating total capital stock to total national product. But we are interested in capital formation, i.e., additions to or changes in capital stock; and these are perhaps more directly affected by *changes* in national product. It may be helpful, therefore, to calculate the marginal capital-output ratios, i.e., the ratios of changes in capital stock to changes in national product. In this calculation, the results of which are shown in Table 7, we use capital stock at the mid-point of a decade and average annual national product for each decade, dividing the change in the successive intervals in the capital stock totals by the change in the successive decadal levels of national product.[5] The variants parallel those in Table 6; but in grouping the decadal intervals into longer ones, we have intentionally

[5] As already suggested, it would have been more defensible to allow some lag between additions to capital stock and those to output, on the premise that some time may elapse between installation of additional capital equipment and its initial contribution to additional output. In the present calculations no significant time lag is allowed for.

The reason is that no data for any acceptable estimate of the lag are available. Furthermore, unless the lag is substantial—and we have no basis for such an assumption—the extension of the interval over which changes are being compared would reduce to insignificance the proportional effect of the lag on the capital-output ratio. Since we are interested in the long-term capital-output ratios, the lag problem is of little importance here, unless it is of the type discussed in Chapter 4, i.e., of a long-term character observed in some industries in the early periods of their growth.

TABLE 7

RATIO OF CHANGES IN CAPITAL STOCK [a] TO CHANGES IN AVERAGE ANNUAL NATIONAL PRODUCT PER DECADE, BASED ON VOLUMES IN 1929 PRICES, 1869–1955

Intervals [b]	*Ratio of Changes in Gross Capital Stock to Changes in Gross National Product*		*Ratio of Changes in Capital Stock Net of Retirements to Changes in Net National Product*		*Ratio of Changes in Net Capital Stock to Changes in Net National Product*	
	Variant I (1)	Commerce Concept (2)	Variant I (3)	Commerce Concept (4)	Variant I (5)	Commerce Concept (6)
Total						
1. 1873–1883	3.7	3.6	3.1	3.0	2.4	2.3
2. 1883–1893	7.7	7.2	6.9	6.4	5.2	4.9
3. 1893–1903	5.8	5.4	4.8	4.5	3.5	3.2
4. 1903–1913	8.1	7.4	7.2	6.4	4.8	4.3
5. 1913–1923	7.1	6.3	5.7	5.0	3.7	3.2
6. 1923–1933	45.0	25.6	33.9	16.2	20.0	9.6
7. 1933–1943	4.4	2.8	1.9	1.1	1.2	0.7
8. 1943–1952 (mid-year)	5.2	5.3	2.3	2.4	1.7	1.8

Total, excluding military						
4a. 1903–1913	8.2		7.3		4.8	
5a. 1913–1923	6.7		5.3		3.4	
6a. 1923–1933	44.2		40.4		24.3	
7a. 1933–1943	4.3		1.7		0.9	
8a. 1943–1952 (mid-year)	3.9		1.8		1.2	
Longer Intervals						
Total						
9. 1873–1893	5.5	5.2	4.7	4.5	3.6	3.4
10. 1893–1913	6.9	6.4	5.9	5.4	4.1	3.8
11. 1903–1923	7.5	6.7	6.3	5.5	4.1	3.7
12. 1923–1952 (mid-year)	6.4	4.9	3.2	2.4	2.1	1.5
Total, excluding military						
9a. 1873–1893	5.5		4.7		3.6	
10a. 1893–1913	7.0		6.0		4.1	
11a. 1903–1923	7.3		6.0		3.9	
12a. 1923–1952 (mid-year)	5.7		2.8		1.7	

[a] Changes in capital stock represent capital formation.

[b] The interval for capital stock is the difference between successive mid-decade dates indicated in Table 6. The decadal flow figures for national product cover the period from the mid-point of one decade to the next in Table 6. The dates for capital stock and for product flow are the same, and hence the resulting intervals coincide. Dates are for end of year unless otherwise noted.

SOURCE: Calculated from the capital stock and national product estimates underlying Table 6, and summarized in Tables 3 and 5.

assembled them in such a way as to distinguish the period after the 1920's from the earlier ones.

4. The marginal ratios for the decadal intervals are quite variable. Even if we disregard the extreme results for the intervals affected by the depression of the 1930's and the decade immediately following, the variations in the marginal ratios are far wider than those in the average ratios. This was to be expected.

5. Of more importance here are the ratios for the longer intervals. These reflect the pattern of movement over time already shown by the average ratios in Table 6—the rise to the 1920's and the decline thereafter. The only modification here is in timing: for net capital stock, the marginal ratios cease to rise, or show a decline, after the second interval, and this is true also for gross capital stock, net of retirements, excluding the military. But of more interest is the fact that the recent decline is much greater in the marginal than in the average ratios. In other words, the downturn in the capital-output ratios in the recent period, that is, after the 1920's, is much more prominent in the marginal ratios—a mathematical necessity, since reversal in the direction of a line means a greater change in the first differences. But this again points up the question how we can evaluate such a marked turn in the relation between changes in national product and in capital formation.

After this brief summary of the statistical evidence on nationwide capital-product ratios, we address ourselves to the wider implications of the measures, and ask what ratios of this type can contribute to our understanding of the factors that determine levels of and trends in capital formation. Such a broad question can hardly be treated exhaustively; but we touch upon a few major points that should guide us in further analysis.

1. One of the apparently important aspects of the ratio is the underlying notion of technological necessity or constraint—the indispensability of capital in the production of goods, and hence the implied indispensability of capital formation in the production of additional quantities of goods. If this notion is valid, further analysis should stress the technological factors that may have determined the levels of the capital-product ratios indicated in Tables 6 and 7, and the technological changes that may have accounted for the indicated movement of the ratios over time.

This element of technological necessity or constraint actually does

exist, as is evident if we consider some specific product. For instance, transportation services of the speed and convenience and at the price that railroads provide cannot be supplied unless there is antecedent capital accumulation in the form of railroad stock, rolling equipment, and so on. The same is true of thousands of products that cannot be turned out by direct labor alone. If we envisage national output as a congeries of specific products and assume that some or many of these specific products literally cannot be produced by direct labor alone, without some reproducible capital, it can be argued that the pre-existence of some capital stock is a necessary condition. In this sense some minimum positive capital-output ratio must exist. But even this conclusion is contingent upon the assumption that national output or product is not limited to items that are producible by natural resources and labor alone.

2. The minimum capital-output ratio assumed above, however, tells us little concerning the actual level of the capital-output ratio except that it is above zero. How large it would or should be is less a matter of technology than of economics; and the greater the economic element, the greater the doubt that the capital-output ratio is an illuminating approach to the analysis of capital formation.

Our reasons for discounting the purely technological constraints are numerous, but one should serve to illustrate our point. To provide railroad services requires some minimum of capital stock: but the track can be of solid and heavy construction or it can be two streaks of rust over the plain; the rolling equipment can be brand-new and modern, or it can be purchased secondhand and boast no new features whatever. In short, wide variations in the real value of the numerator are possible—naturally above some rock bottom minimum—and these variations will be largely governed by economic considerations. Likewise, there may be appreciable variations in the denominator. Under certain conditions, it may be advantageous to run the equipment—the capital—continuously, and the total product (say, during a year) to which the capital stock is related may thus be quite large, and the capital-output ratio low. Under others, it may be more advantageous to run the equipment at lower capacity and, with a correspondingly lower output, the capital-output ratio will be high. Thus, even for a specific product, and even disregarding cyclical fluctuations, it is perfectly possible, indeed quite realistic, to expect that different economic conditions (say, in different countries and epochs, and without regard to any technological changes) will cause a wide range in capital-output

ratios, all above the minimum dictated by purely technological constraints.

3. It is because of the possible dominance of these economic elements in the determination of the capital-output ratios that those in which the net capital stock is the numerator have more meaning. When we deduct depreciation we allow the economic elements of opportunity cost to operate in determining the rate of utilization of capital that may still be physically present: the proportion of net to gross capital stock is the economically rational long-term rate of utilization of gross capacity. Hence in relating net capital stock to output we are, in fact, relating capital stock weighted by its rational rate of capacity utilization, whereas, in relating gross capital stock to output the stock is treated as a congeries of physical units whose total capacity is not utilized. For this reason, the behavior of the resulting net capital stock ratios may be explained more easily than the gross ratios.

4. If, with a given technology, economic factors may produce wide variations in the ratio of capital to output for a single product, the economic—as distinct from purely technological—factors must have even greater effects when we deal with a wide congeries of products, among which there can be substitution. If, to continue the earlier illustration, we consider freight transportation services, there is a choice among railroads, trucks, and sometimes water transport, and in this choice the different capital-output ratios, or rather the implied differences in relative cost of capital, may play a part. Thus, if national product is regarded as response to a basket of broadly defined needs—sustenance, clothing, shelter, transportation, and so forth—with specific goods substitutable for each other in satisfying each major category of needs, the existing technology admits of wide differences in the minimum ratio of capital stock to output; and related economic factors widen the range of these differences.

It follows that technology, as a constraining factor, accounts for but a minor part of our problem. To put it simply: given a current level of national income and a stock of technological knowledge, the "required" capital—the stock indispensable for the production of that national income total, broadly subdivided into major final product categories—would be but a small part of the actual capital stock except in the most underdeveloped countries. Even if we coupled the given total national product with some minimum level of product per capita, reference to existing technology would yield—under different economic conditions—a wide range of possible capital-product ratios. This can be

clearly seen when one observes the framework of the "engineering" estimates of capital-output ratios: they are calculable only on the basis of detailed specifications of economic conditions—costs of labor, transportation, etc. In short, technological considerations do little to explain why the nationwide ratio of capital to output should be 3 to 1, and not 1 to 1, or 10 to 1. And insofar as the explanation lies in economic rather than technological constraints, the direction of further search may be more clearly suggested by other statistical relations, which do not acquire their meaning from technological implications.

5. What has just been said about the bearing of technological factors on capital-output ratios at a point of time applies also to trends over time. True, technological considerations may provide some hypotheses as to the probable course of long-term movements in capital-output ratios, and hence of volumes of capital formation. Thus, all other conditions being equal, the long-term trend in net capital-output ratios should be downward: "replacement" being substitution of more efficient tools, it should be continuously possible to produce greater output with the same or even smaller *net* capital stock. On the other hand, many technological changes that result in the creation of new products and new tools may raise—at least for a while—the nationwide capital-output ratio, either by requiring more elaborate tools which embody resources that are in a higher ratio to current annual output, or by stimulating expansion of durable capital which for some time is in advance of the growth of final output. In fact, in subsequent discussion of the patterns of capital formation in the major industrial sectors of the economy, we shall use hypotheses based largely on technological considerations.

But granting the usefulness of these hypotheses, one may still doubt that technological factors are dominant in determining the long-term trends in *nationwide* capital formation, or nationwide capital-output ratios, if by technology we mean inventions and improvements associated with the stock of engineering and other knowledge. For economic and other considerations—changing pressures and forms of organization—exercise a major influence on the trends as well as on the levels of the capital-output ratios. Repeatedly in the past, great improvements have been effected in utilization of capital under conditions in which the technological framework has remained unchanged—as in the United States during the 1930's. In the course of its long-term economic growth, a nation can choose between high and low capital-output industries, and its choice will be made in the light

of availabilities of resources for capital formation, that is, largely in terms of the costs of withdrawing them from current consumption. With such a choice, and the changing conditions that affect it, long-term trends in nationwide capital-output ratios may well reflect trends in the supply of savings much more than trends in capital presumably required technologically by some pattern of relations between specific baskets of final products and capital indispensable for producing them.

6. The comments above are not meant to minimize the importance of technological processes and changes, and of considerations and hypotheses based upon them, in the analysis of capital formation and economic growth. In fact, we hope they will prove fruitful at a later stage in the analysis when, having dealt as best we can with the determinants of the over-all nationwide rate of capital formation, and of the long-term trends in the nationwide levels, we deal with the separate capital using sectors. At that point, the time sequence of technological change in these sectors, and their different levels of capital-output ratios may help to explain the changing apportionment of nationwide capital formation among major user sectors. Also, if we were concerned with the explanation of trends in total national product, technological changes (additions to the stock of knowledge) would play a major part in the explanation. But in the problem before us here—the attempt to explain the levels of and trends in nationwide capital formation—we find the technological factors overlaid and dominated by a variety of economic and social factors. More specifically, we doubt that pushing the analysis into consideration of the capital-output ratios for types of industries or products would add much to the explanation of the levels and trends in countrywide volumes of capital formation. This conclusion, which reflects the view that the observed capital-output ratios are economic rather than technological measures, leads to the inference that the ratios are radically incomplete in their rationale, in that they do not lead to proper emphasis on the supply of savings—a major factor determining them. In view of the importance of this factor, the technologically colored plausibility of the capital-output ratios is likely to lead us away from rather than toward the forces that determine—at least on a nationwide basis—the levels and trends in capital formation. To direct our attention to these forces, we must restate the relation between capital formation and national product, and regroup our totals.

Capital Formation and Savings-Income Proportions

The discussion above has indicated the possible importance of viewing capital formation as the saved part of current product, and of directing attention to the factors that govern savings-income proportions and may determine, with changes in income, the levels of capital formation and its trends. This obviously involves calculating the share of gross capital formation in gross national product, and of net capital formation in net product. The shares for the several variants of national product are shown in Table 8. Again, for continuity with the preceding discussion, the underlying totals are in constant prices.

Over the successive decades the proportion of gross capital formation to gross national product shows a fair degree of stability through the decade of the 1920's. It ranges from somewhat over 20 per cent to 26 per cent in the two variants, and, when averaged for periods of not less than twenty years, shows no significant trend before the 1930's. This constancy for some six decades at a level averaging somewhat below one-quarter is one of the few unchanging trends in our analysis so far.

After the 1920's the movement in the proportion of gross capital formation to gross national product is more erratic. In both variants there is a significant drop during the depressed decade of the 1930's, and the subsequent movement is greatly affected by military capital formation. If we include the latter, the proportion after the 1930's is only slightly lower than that preceding the 1930's—at least in Variant I. If we exclude the military, the proportion of gross capital formation even after the 1930's is distinctly lower than that prevailing from 1869–1878 through 1919–1928. On the whole, we can conclude that after some six decades of relative stability, the gross capital formation proportion declined, particularly noticeably if we exclude military capital formation.

The stability in the gross capital formation proportion can be seen as a combination of two opposite trends: in both variants the proportion of capital consumption to gross national product rises, and that of net capital formation declines, the latter particularly after 1908. Net capital formation tends to decline not only as a proportion of gross national product but also as a proportion of net national product. However, the decline is not conspicuous until the 1909–1918 decade. From about 15 per cent of net national product during the first four decades,

TABLE 8

PERCENTAGE SHARES OF CAPITAL FORMATION IN NATIONAL PRODUCT, BASED ON VOLUMES IN 1929 PRICES, 1869–1955

Periods	*Per Cent of Gross National Product*			*Per Cent of Net National Product*
	Capital Consumption (1)	Net Capital Formation (2)	Gross Capital Formation (3)	Net Capital Formation (4)
	VARIANT I			
Total				
1. 1869–1878	9.5	13.9	23.4	15.4
2. 1879–1888	9.8	13.1	22.9	14.5
3. 1889–1898	12.1	14.0	26.0	15.9
4. 1899–1908	11.3	12.9	24.2	14.6
5. 1909–1918	12.3	11.2	23.4	12.7
6. 1919–1928	12.3	9.9	22.3	11.3
7. 1929–1938	13.0	1.8	14.8	2.1
8. 1939–1948	14.2	6.1	20.3	7.1
9. 1946–1955	15.5	4.9	20.4	5.8
Total, excluding military				
5a. 1909–1918	12.3	10.3	22.6	11.7
6a. 1919–1928	11.5	10.4	21.9	11.8
7a. 1929–1938	12.6	1.8	14.4	2.1
8a. 1939–1948	12.1	3.7	15.9	4.3
9a. 1946–1955	12.2	6.6	18.8	7.5
Longer Periods (averages of percentages)				
Total				
10. 1869–1888	9.6	13.5	23.2	15.0
11. 1889–1908	11.7	13.4	25.1	15.2
12. 1909–1928	12.3	10.6	22.8	12.0
13. 1929–1955	14.1	4.2	18.3	4.9
Total, excluding military				
10. 1869–1888	9.6	13.5	23.2	15.0
11. 1889–1908	11.7	13.4	25.1	15.2
12a. 1909–1928	11.9	10.4	22.2	11.8
13a. 1929–1955	12.4	3.6	16.0	4.1

(continued)

TABLE 8 (concluded)

Periods	*Per Cent of Gross National Product*			*Per Cent of Net National Product*
	Capital Consumption (1)	Net Capital Formation (2)	Gross Capital Formation (3)	Net Capital Formation (4)
	COMMERCE CONCEPT			
Total				
14. 1869–1878	9.3	13.7	22.9	15.1
15. 1879–1888	9.5	12.7	22.2	14.0
16. 1889–1898	11.6	13.5	25.1	15.2
17. 1899–1908	10.7	12.3	23.0	13.8
18. 1909–1918	11.5	10.5	22.1	11.9
19. 1919–1928	11.4	9.2	20.6	10.4
20. 1929–1938	11.8	1.6	13.4	1.9
21. 1939–1948	11.2	4.8	16.0	5.4
22. 1946–1955	13.2	4.1	17.3	4.8
Longer Periods (averages of percentages)				
23. 1869–1888	9.4	13.2	22.6	14.6
24. 1889–1908	11.2	12.9	24.0	14.5
25. 1909–1928	11.4	9.8	21.4	11.2
26. 1929–1955	11.9	3.4	15.3	3.9

Because of rounding, detail will not necessarily add to total.

SOURCE: *Gross and net national product:* Decade averages given in or calculated from Tables R-2 and R-12 (see also notes to Table 5).
Capital consumption and capital formation: Decade averages given in or calculated from Tables R-5, R-8, R-15, and R-17.

For each decade, the percentage was calculated from the arithmetic mean of absolutes, not as the arithmetic mean of the percentage for each year in the decade.
The averages of percentages in lines 10–13, 10a–13a, and 23–26, were derived from the decadal entries in the lines above. For 1929–1955 we computed the weighted mean of the percentage for 1929–1938, 1939–1948, and the seven-year period 1949–1955.

the proportion of net capital formation drops to between 11.2 and 12 per cent in 1909–1928, is catastrophically affected by the depression of the 1930's, and in the prosperous decade, 1946–1955, constitutes only 4.8 to 5.8 per cent.

If we view these capital formation shares as savings proportions, there is one obvious limitation to the evidence in Table 8: it relates

to volumes in constant prices. Conversion to constant prices is useful if our interest lies in the allocation of real resources between flow of goods to consumers and additions to capital stock. Our interest here lies, however, in the allocation of money income (including the proportionately small amount of income in kind) between that used for consumption purchases and that constituting savings. Since decisions by individuals and firms between spending and saving are perhaps more closely related to money income, it may be more useful to study capital formation or nationwide savings proportions for totals in current prices. For this reason we include here, for the first time in our discussion, estimates based on totals in current prices (Table 9).

The proportions based on the totals in current prices show movements somewhat different from those in the proportions based on the constant price totals, the reason being that the price trend in capital formation (affected largely by construction) shows a somewhat greater long-term rise than that in national product as a whole. We now list the findings based on values in current prices.

1. The proportion of gross capital formation to gross national product is relatively constant, at a level close to or somewhat above 20 per cent in both Variant I and the Commerce series. For the longer terminal period, 1929–1955, there is some decline in Variant I if we exclude the military, and in the Commerce estimates even in the total. For the decade 1946–1955, however, the level in each set of estimates is about the same as that prevailing before the 1930's. Thus, by and large, one can conclude that, for totals in current prices, there has been a rough long-term constancy in the gross capital formation proportion—at about or somewhat over 20 per cent.

2. The proportion of capital consumption to gross national product rises, both in Variant I and in the Commerce series. For the longer periods, the rise is from somewhat over 8 to 13.3 or 15.6 per cent. As we shall see in the next chapter, it is a reflection partly of the retardation in the rate of growth of capital formation itself, partly of the shift from the longer-lived construction to the shorter-lived producers' equipment.

3. The proportion of net capital formation to net national product is fairly constant until 1909–1918: between 13 and 13.9 per cent in Variant I and between 12.4 and 13.2 per cent in the Commerce series. It drops down to either 11.8 or 10.8 per cent in 1909–1928, and declines drastically thereafter. The highest recent rate, 9.0 per cent, is for

TABLE 9

PERCENTAGE SHARES OF CAPITAL FORMATION IN NATIONAL PRODUCT, BASED ON VOLUMES IN CURRENT PRICES, 1869–1955

Periods	*Per Cent of Gross National Product*			*Per Cent of Net National Product*
	Capital Consumption (1)	Net Capital Formation (2)	Gross Capital Formation (3)	Net Capital Formation (4)
	VARIANT I			
Total				
1. 1869–1878	8.0	12.3	20.3	13.4
2. 1879–1888	8.7	11.8	20.6	13.0
3. 1889–1898	10.7	12.5	23.1	13.9
4. 1899–1908	10.5	12.4	22.8	13.8
5. 1909–1918	11.5	10.6	22.1	12.0
6. 1919–1928	12.1	10.3	22.4	11.7
7. 1929–1938	13.8	2.1	15.9	2.5
8. 1939–1948	15.7	6.1	21.8	7.3
9. 1946–1955	17.6	6.0	23.6	7.2
Total, excluding military				
5a. 1909–1918	11.5	9.4	20.9	10.7
6a. 1919–1928	11.3	10.8	22.0	12.1
7a. 1929–1938	13.4	2.1	15.5	2.5
8a. 1939–1948	13.2	3.9	17.1	4.5
9a. 1946–1955	14.2	7.7	21.9	9.0
Longer Periods (averages of percentages)				
Total				
10. 1869–1888	8.4	12.0	20.4	13.2
11. 1889–1908	10.6	12.4	23.0	13.8
12. 1909–1928	11.8	10.4	22.2	11.8
13. 1929–1955	15.6	4.7	20.2	5.6
Total, excluding military				
10. 1869–1888	8.4	12.0	20.4	13.2
11. 1889–1908	10.6	12.4	23.0	13.8
12a. 1909–1928	11.4	10.1	21.4	11.4
13a. 1929–1955	13.7	4.2	17.9	4.9

(continued)

TABLE 9 (concluded)

Periods	*Per Cent of Gross National Product*			*Per Cent of Net National Product*
	Capital Consumption (1)	Net Capital Formation (2)	Gross Capital Formation (3)	Net Capital Formation (4)
	COMMERCE CONCEPT			
Total				
14. 1869–1878	7.8	11.9	19.8	12.9
15. 1879–1888	8.4	11.4	19.8	12.4
16. 1889–1898	10.2	11.8	22.0	13.2
17. 1899–1908	9.8	11.6	21.4	12.9
18. 1909–1918	10.7	9.9	20.5	11.0
19. 1919–1928	11.2	9.5	20.6	10.7
20. 1929–1938	12.6	1.9	14.5	2.2
21. 1939–1948	12.6	4.9	17.5	5.6
22. 1946–1955	15.1	5.1	20.2	6.0
Longer Periods (averages of percentages)				
23. 1869–1888	8.1	11.6	19.8	12.6
24. 1889–1908	10.0	11.7	21.7	13.0
25. 1909–1928	11.0	9.7	20.6	10.8
26. 1929–1955	13.3	3.9	17.2	4.5

Because of rounding, detail will not necessarily add to total.

SOURCE: *Gross and net national product:* Decade averages given in or calculated from Tables R-1, R-6, and R-11. The Commerce series was estimated by converting the gross national product series in constant prices (see Table 8) to current prices by an index calculated by extrapolating the implicit price index for 1929–1938 by the implicit price index in our Variant III series for the earlier years. From the resulting estimates of gross national product in current prices we subtracted our estimate of capital consumption (see below).

Capital consumption and capital formation: Decade averages given in or calculated from Tables R-4, R-8, R-14, and R-16. For procedure used in calculating the percentages for decades, and the averages of percentages for longer periods, see notes to Table 8.

Variant I for 1946–1955, for the share of net capital formation in net national product, both excluding net military investment.

We may now ask how the view of capital formation as the saved portion of national product helps us understand the factors that determine the volumes of and trends in capital formation. It would be

impossible here, and for that matter anywhere—with our limited knowledge—to develop a cogent theory that would connect the saving process with capital formation, and would explain why the levels and trends of capital formation are of the order suggested by our estimates. But it is possible and useful to sketch the lines of connection and influence and thus point the way for further analysis.

In this outline we begin with net capital formation, try to connect it with the net saving process, and then deal with capital consumption, the other component of gross capital formation, treating it as a function of the long-term cumulation of past net capital additions.

1. Our initial observation is that net capital formation may be financed out of personal savings (including those of unincorporated enterprises, whether farm or nonfarm), out of undistributed profits or net income of corporations, and out of government funds (the excess of current revenues over current expenditures). Goldsmith's monumental study of saving helps us to see roughly the relative importance of these three sources of financing in total net savings or total net capital formation since 1897. During the two periods unaffected by war and major depressions, 1899–1908 and 1919–1928, personal savings accounted for over 70 per cent of all net savings or net capital formation; corporate savings, for about 21 per cent; and government savings, for almost 7 per cent.[6] During the war-affected decades, 1909–1918 and 1939–1948, governments incurred substantial dissavings, and total personal savings were either close to or far exceeded total net capital formation. With total net savings or net capital formation averaging in nonwar and nondepression decades between 12 and 13 per cent of net national product, personal savings contributed between 8.5 and slightly over 9 per cent of net national product, corporations almost 3 per cent of national product, and governments somewhat less than 1 per cent of national product. In terms of disposable personal income, personal savings in the "normal" periods were about 10 per cent.

These rough orders of magnitude—which would have to be modified if we carried the estimates back to the nineteenth century when net savings or net capital formation proportions were somewhat higher—indicate that we must pay most attention to the factors that determine personal savings. In a country with an economic and social structure

[6] See Raymond W. Goldsmith, *A Study of Saving in the United States,* Vol. I (Princeton University Press, 1955), Table T-1, p. 345. In Table S-12, p. 271, Goldsmith shows the shares of major saver groups in the "normal" period to be about 72 per cent for personal, 20.4 per cent for corporate, and 7.4 per cent for government.

such as ours, the proportion of net savings that can be contributed either by corporations or by governments will necessarily be limited. The executive branches of the government are not permitted to use large proportions of current revenues—let alone large proportions of total national product—for capital investment. There is little justification for levying taxes upon individuals and the private business sector to permit the government to finance capital undertakings without interest charges, except in a major war when the government is forced to make huge military capital investments. Under such conditions current expenditures are likely to exceed current revenues, so that not only military capital formation but even part of current expenditures may be financed out of savings of individuals and corporations. In other words, the secular level of government capital formation financed out of current revenues rather than borrowing, in nonauthoritarian societies like the United States, is bound to be a minor fraction of national product and, indeed, of total net savings or capital formation.[7]

The limits on the net savings contributed by corporations are not as narrow as those on governments' contributions, but they are confining nevertheless. To begin with, net income originating in corporations is only a fraction of the country's national income: since 1929 the share has been somewhat more than one-half, and it was probably lower in the earlier decades.[8] The share of national income originating in corporations that could be classified as total net profits, after all expenses but before payment of taxes and dividends, is limited by competition of other corporations and by noncorporate enterprises engaged in business. It is limited also by taxes, which increase as net profits increase whether the profits are paid out as dividends or retained as undistributed earnings. And, finally, even disregarding the large corporate sector in public utilities that is subject to special limiting regulations, most corporate business is carried on by units whose shares are traded on public investment markets. Any tendency to keep the level of undistributed profits unduly high exposes such corporations—if their

[7] This statement is, of course, too simplified and rigid. Changing technology may increase the share of government savings, by permitting the use of taxes for capital investment, such as construction of highways. Changing demand may induce governments to use taxes for construction of hospitals, and changing political views may well enlarge the share of governments in savings and capital formation even in times of peace. The statement in the text is a capsule summary of limitations on the share of governments in the saving process as they characterized most of the period before World War II.

[8] See *U.S. Income and Output* (Supplement, *Survey of Current Business,* 1958), Table I-12, pp. 134–135.

shares are widely held—to possible "capture" by outsiders, since the price of their shares may be more affected by the level of their dividend payments than by that of their net profits. All these circumstances combined would tend to keep corporate savings at limited proportions of net profits, at even lower proportions of net income originating in the corporate sector, and, finally, at quite low proportions of national income or net national product. These comments should, of course, be supplemented by analysis showing the quantitative limits in actual operation—a task beyond the scope of this study. However, although the comments do not indicate why the share of corporate savings in recent decades is less than 3 per cent of net national product or only about one-fifth of all net savings, they do suggest the variety of factors that limit rather narrowly the share of corporate savings.

2. Turning to the main source of net savings, individuals, we begin by suggesting that the indicated savings proportions—about 10 per cent of their disposable income in "normal" times, and perhaps 11 or 12 per cent in the decades from 1870 to 1900—seem quite low. It should be remembered that according to our estimates, per capita income, and presumably also per capita disposable income, was rising over the period at a rate of about 17 per cent per decade. Such a rate means that in just two decades per capita income in real terms would rise from an assumed initial level of 100 to 136.9. Assume for the sake of illustration that, with a constant population, consumption was 100 in the first decade (i.e., no savings) and that by the third decade consumption rose only 10 per cent. Then in that third decade individuals' savings would be 26.9 out of 136.9 or close to 20 per cent. The illustration is unrealistic in several ways, but it serves to stress the major point: the persistence of a limited ratio of personal savings to income, under conditions of a relatively high rate of growth in real per capita income, means that all but a small fraction of the gain in income is absorbed in increased consumption. It follows that one major factor in explaining the rate of personal savings, under such conditions of growth as occurred in the United States, is the great responsiveness of consumption, as evidenced by its capacity to absorb all but 10 per cent (slightly more in the earlier decades) of the gain in per capita income.

This is hardly the place to deal with the aspects of the economic and social structure of the United States that explain this pressure for ever-rising levels of consumption per capita. Many come easily to mind: the relative freedom of individuals and consumers; the widespread

social mobility that has characterized our society; the increasing concentration of population in cities, where the practice of imitation (the so-called "demonstration effect") is so natural, making higher consumption levels necessary if only to offset the increasing discomforts of urban life. Indeed, the fact that economic growth has been attained so largely by technological discovery and improvement—creating new products for ultimate consumers—and that this technological change has been further impelled by imbalances created in the past (with more cars creating the need for more roads, and the like), suggests that rising consumption levels are a built-in feature of the whole process of economic growth in this country.[9]

With the pressure for high-level consumption in mind, any consideration of why the personal savings-income proportion was at a given level, would involve analysis of the factors that impel such savings, despite the pressure for use of current income for current consumption. Such analysis would proceed most effectively from the oversimplified but nevertheless useful dichotomy between the vast majority of people whose income position is below the very top and whose savings, therefore, have to be tailored to the indispensable needs which such savings must satisfy, and the very top group of income recipients who can afford a much higher savings-income rate without limiting their consumption standards. Our current data on savings-income patterns are unfortunately affected too much by the use of annual income as the basis for classification by size, and the transient elements in such income make for an exaggerated contrast between savings in the top brackets and dissavings in the lower brackets. We might divide the whole body of personal savers into two groups: the overwhelming majority—say, the lower 95 per cent classified by their relatively permanent income position—who perhaps account for 80 per cent of income and 50 per cent of total personal net savings; and the top 5 per cent who account for the other 50 per cent of total personal savings. A countrywide savings-income rate of 10 per cent under these conditions implies a savings-income ratio of about 6 per cent (or 5:80) for the lower 95 per cent, and of 25 per cent (5:20) for the top 5 per cent. The figures are illustrative, intended only to suggest the broad lines of the dichotomy.[10]

[9] See Ruth P. Mack, "Trends in American Consumption and the Aspiration to Consume," *American Economic Review,* May 1956, pp. 55–68.

[10] Much of the discussion that follows was presented in Kuznets, "Economic Growth and Income Inequality," *American Economic Review,* March 1955, pp. 1–28, par-

3. For the lower group of income recipients, hereafter referred to as the L group, savings are geared to minimum needs, which may arise from many considerations: cash balances against sudden emergencies; saving for future bulk purchases or expenses; and saving for retirement. We know too little about practices with respect to these savings needs, but the dominant one—saving for retirement—lends itself to a simple illustration that indicates the major demographic and economic forces involved.

Assume for simplicity that the working, income-earning life of an individual is 40 years, from, say, age 20 to age 60; the expected retirement period is 10 years, from 60 to 70; and no allowance is made for any legacy or the like. Assume also that the income needs during retirement are one-half the total annual income during active life. Then if we disregard interest accumulation, savings needed for retirement would equal one-eighth of the average annual income during the 40 years of active life ($^{10}/_{40}$ multiplied by $\frac{1}{2}$), a savings-income ratio of 12.5 per cent. An allowance for interest, which would depend upon the rate that is assumed, the time pattern of earnings, and the time pattern of retirement expenditures, would presumably bring the savings-income ratio well below 12.5 per cent.

However, if population, other demographic variables, and per worker income are constant, and the retirement savings scheme out-

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ticularly pp. 7–12. See also Appendixes C and D of *idem*, "International Differences in Capital Formation and Financing," *Capital Formation and Economic Growth* (Special Conference Series, No. 6, Princeton for NBER, 1955), pp. 82–106.

This chapter was written before I read Milton Friedman's *A Theory of the Consumption Function* (Princeton for NBER, 1957). His analysis would lead me to qualify the magnitude of difference in the savings-income ratios suggested, although it is already much narrower than that suggested by statistical data for pre-World War II years. But these would be largely qualifications, for two reasons. First, I am dealing here with permanent income more in the sense of lifetime income than with the distinctive concept that Friedman employs—the empirical counterpart of which appears to be a level characterizing a period of about three years. For lifetime income, I see no escape from the conclusion that units whose average income is near the subsistence level would have a savings-income ratio of close to zero; and that units whose lifetime income is high in the scale, and who would presumably wish to preserve that position for themselves and their descendants, would have fairly high savings-income ratios. Second, even Friedman finds that his permanent savings-income ratios for entrepreneurs are double those for employees; and while he ascribes the difference to a greater income dispersion for the former, the association with the difference in permanent income levels is not denied. It is quite possible that further differentiation among socio-economic groups distinguished by different lifetime income levels (or even Friedman's permanent income levels) would yield a further variation in the savings-income ratio.

lined above is actually followed, total dissavings of retired persons would exactly equal the current savings of people still in the active labor force, and aggregate savings would be zero, not 12.5 per cent or less of total income of the population. But population and per capita income do grow. In the United States the income mass or total income in real terms grew at the rate of about 37.5 per cent per decade. In the illustration above, the average time span between active and retired life is something like 25 years. Hence the income level and savings of active workers exceed the expenditure-dissavings level of the retired group by the ratio of (1.375 raised to the power of 2½) to 1, or 2.217. The aggregate savings then are 12.5 per cent multiplied by 1.217, or roughly 15 per cent of an income mass which in relation to the actual is as 1 is to 2.217. The implicit aggregate net savings-income fraction is then 15 per cent divided by 2.217, or slightly less than 7 per cent.

The illustration is, of course, hypothetical: the empirical coefficients are roughly realistic, but the assumption of retirement needs is purely notional. Its importance, however, is that it suggests the major factors that determine the aggregate savings-net income ratio for the overwhelming proportion of the income earning population: not only their savings plans but also the relative magnitudes of the active and the retired population, and the differences between their expenditure levels. It would be relatively easy to shape the empirical coefficient to yield an aggregate savings-income proportion of some 5 to 6 per cent. While this would be partly a matter of arbitrary design, one should note that many of the coefficients used—the relative duration of active and of retirement life, the rate of growth in numbers of population and of active workers, and in per capita real income—are fairly realistic. One can legitimately argue that in this direction lies the promise of explaining why the personal savings-income proportions in the United States were 10 to 12 per cent, and not 2 to 3, or 20 to 30. Such an explanation would also bring us close to understanding why the net capital formation proportions in net national product before the 1930's ranged from 11 to 14 per cent, and not from 2 to 4, or from 20 to 30.[11]

[11] The analysis in the text, which deals with savings and dissavings associated with retirement, can be applied to savings connected with or in anticipation of any future expenditures (dissavings). Thus, in the early years of marriage before the arrival of children, funds may be saved as a reserve against expenditures on children; and then, with their arrival, a period of dissaving may ensue. The pattern of analysis of such expenditure-oriented savings, and the problem of weighting the individual life-cycle patterns into aggregates in a growing population with growing per capita income would be the same as those suggested in the text.

4. This outline of the factors involved in determining the personal savings-income rate for the L group at a given point of time, is useful also in suggesting the possible long-term trends. In general, the rapid rise in real income per capita suggests the possibility of an upward movement in the savings-income ratio. That movement may be offset to some extent by such counteracting factors as the desire and need for higher consumption occasioned partly by changing conditions of life (urbanization, need for greater education and training, and the like) and partly by the stimulus of new products. The more interesting implication of the scheme outlined above, however, lies in the demographic and income-growth factors. All other conditions being equal, retardation in the rate of growth of population and of per capita income would produce a lower aggregate net savings-income ratio. Thus, if in the illustrative example we had assumed that the population and per capita income grew at the rate of 5 per cent per decade, yielding a decadal rate of growth of total income of 10.25 per cent (rather than the 37.5 per cent shown in our Variant I estimates and used in the illustration), the aggregate net personal savings rate derived for the L group would have been only 2.7 per cent instead of about 7. (With a decadal rate of growth of 10.25 per cent, the cumulation over twenty-five years yields an income mass of 1.276, and the savings rate equals 12.5 per cent multiplied by 0.276, divided by 1.276.)

It follows that, with the retardation in the rate of growth of national income observed in the United States, the factors suggested above as determining savings would make for a secularly lower personal savings-income ratio—provided the other assumptions of the hypothetical scheme remained constant. But they need not remain constant: the duration of retirement life relative to that of active life may become longer than that assumed in the calculation; the proportion of active-life income desired for retirement life may rise. Moreover, other needs for savings—emergencies or bulk purchases—though minor, may be subject to trends of their own. Clearly, we are dealing here with a complex situation in which forces of vast variety are operating, some making for a higher savings-income ratio for the L group, others tending to produce a lower ratio as time goes on. All we can do here is indicate the factors that seem important, and that would therefore suggest directions in which further research could fruitfully be undertaken. It seems particularly useful, also, to indicate in such an outline the relations by which one aspect of economic growth, such as the retardation in the rate of growth of total income, is connected—in

ways that may not have been stressed heretofore—with another, such as the possible constancy of the savings-income ratio in the face of a rising per capita income, or even some tendency for the savings-income ratio to drop.

5. Minimum needs can play only a limited role in determining the savings patterns of the upper group of income recipients (the U group), and consequently, the problem of explaining the level of the savings-income ratio for this group is more difficult. Why, for instance, did we assume, in our illustration of the dichotomy, that the savings-income ratio for the U group was 25 per cent? It could, presumably, have been 50 per cent, since consumption per capita of the U group would still have been over twice that of the L group. Yet if the savings-income ratio of the U group had been 50 rather than 25 per cent, the countrywide personal savings-income ratio would have been 15 rather than 10 per cent.

What, then, limits the savings-income ratio for the U group? It is difficult even to suggest an answer, in our general ignorance of the economics of the small upper groups in society. The only complex of relevant factors that comes to mind is suggested by the continuous gradation of per capita consumption levels and savings proportions that one finds in cross-section studies of family income and expenditures. In these arrays of families grouped in increasing order of income position, there is always a continuous and gradual rise in consumption per head, in savings per head, and in the proportion of savings to income. Particularly in a society like that of the United States, there is no dichotomy of the oversimplified type suggested in our illustration. There is no clear line of division and contrast between the "poor" masses and the "rich" elite, but a great range of "middle" classes forming a continuous bridge from the lowest to the highest levels of the income distribution. The implication of this gradation is that patterns of social and economic life produce—i.e., make possible, and to some extent compel—ever-rising consumption and expenditure standards with rises in relative position in the long-term income scale.

This implication has direct bearing upon our question in the sense of setting some upper limits to the savings-income fraction. To illustrate: at the upper reaches of the L group, before we pass into the U group, the savings-income fraction may be as high as, say, 12 per cent (compared with the average for the L group of about 6 per cent). The next group in the array, in the lower reaches of the U group, may have a per capita income, say, 10 per cent higher; but it would tend to

have a consumption level per capita that would also be somewhat higher. Even if its consumption level were not higher but merely equal to that of the upper segment of the L group, its savings-income ratio could not exceed (12 + 10): 110, or 20 per cent. If, then, consumption levels rise with a rise in the income level, that is, if differentials in consumption persist in response to differentials in income, either because human beings naturally adjust themselves to higher standards of living or because they regard consumption as a symbol of higher social position and thus a means of setting themselves above their neighbors, there are definite limits to the savings-income ratio of the U group. These limits are in fact determined by the desire and need to maintain consumption levels above those of the lower neighboring economic groups.[12]

The precise working out of this hypothesis in quantitative terms, demonstrating why the savings-income ratio for the U group happens to be x rather than y, or s times the ratio for the L group rather than t, would involve analysis of the whole income and consumption structure of the population of this country. Here again all we can do is point out the connecting links—this time between the factors that motivate high-level consumption and the limits set upon the savings-income ratio. But even this is of value, if it directs our attention into the proper channels.

6. What bearing have the savings-income proportions upon long-term trends? For the U group it lies partly in the trend in their savings-income ratio, partly in the trend in their share in total income. An increase in either means a secular rise in the ratio of aggregate savings to total income; a decline means a secular decline in the ratio.

Little new can be said here relative to long-term trends in the savings-income ratio for the U group proper: given the linking of their consumption patterns with the consumption levels of the rest of the population, their savings-income ratio would be subject to the same growth factors as the ratio for the rest of the population would be. And what we have said above about the pressures for high and rising levels of consumption expenditures would apply *pari passu* to the U group, so far as the effects of technical progress in the way of new products and the continuous desire for groups to differentiate themselves from those immediately below would produce a rise in the

[12] In this connection see the emphasis on the demonstration effect and the interdependence of the tastes of consumer units in James S. Duesenberry, *Income, Saving, and the Theory of Consumer Behavior* (Harvard University Press, 1949).

consumption levels of the U group and thus prevent its savings-income ratio from rising.

In dealing with the trends in the income shares, we encounter a new problem. The inequality in the distribution of savings may well be greater, and in fact was greater, in recent decades in the United States, than that in the distribution of property incomes, and hence of assets. This is because of the frequency of a combination of large service incomes with large property incomes. All other conditions being equal, persistence of a higher share of savings than of property in the hands of the U group should result in an even greater concentration of property, hence of property incomes, hence of total incomes. In other words, in the greater concentration of savings in the U group there is a built-in tendency to produce increasing concentration of income—and, to that extent, even further concentration of savings. It is important, therefore, to consider whether any factors tend in the long run to counteract the concentration of savings, and the inferred effect—the secular rise in the income share of the U group.

These counteracting factors can be briefly listed. The most obvious is, of course, intervention on the part of society, in the form of economic legislation relating to both inheritance and income. Just as inheritance taxation was introduced to break up the cumulation of large property holdings—the mechanism by which the tendency suggested above operates—so, in recent decades, progressive income taxation was introduced to limit the relative excess of the per unit incomes of the U group over the per unit incomes of the L group.

But there are more important if less obvious factors. In the demographic growth of a country like the United States, with natural increase much lower in the U group than in the L group, and immigration swelling the numbers in the L group, the relative numerical increase in an initially top group is smaller than in that of the rest of the population. Consequently the U group of the 1870's comprising the top 5 per cent cannot, with its descendants, account for the top 5 per cent of the population in the 1920's. It follows that on this account alone the U group of the 1920's includes a fairly substantial proportion of units that have come up from the lower ranks and the cumulation of whose wealth may not lead to as much concentration of income. An even more important factor lies in the dynamism of the economy of the United States, in the shift of focus of growth, and hence of sources of wealth, from one industry to another, from one area to another. With such shifts, the successful entrepreneurs of a generation ago or

their descendants are rarely among the ranks of the successful today. This change in identity of successful entrepreneurs means continuous turnover in the composition of the top group and prevents persistent accumulation of wealth in the same hands. Finally, one must also consider the service income component of the income of the U group. Already high and tending to be concentrated in the high per capita earnings sectors, it is not likely to rise as rapidly as the per capita service income of the L group, which is affected both by increases within industrial sectors and by shifts in the distribution of the gainfully occupied from sectors with lower per capita earnings to those with higher per capita earnings.

These comments, which suggest the factors that counteract any possible concentration of income in the hands of the U group, in and of themselves tell nothing about the possible trends in its income share. The continuous entry of new economically successful units may be accompanied by a rising share of income for the U group, if the new units capture more of the growing income than was captured by the successful units of preceding generations. Or the share of the U group in income may decline, if the sources of new wealth are not as large proportionately as they were in earlier times. All one can say is that prima facie there is no case for expecting the trend in the income share of the U group to be upward; and that in more recent times factors operated to reduce that share.

7. With the income share and savings-income ratio constant, the savings contribution of the U group, as a percentage of net national product, would also tend to be constant in the long run; or would diminish if, under legislative and other pressures, property yields were to decline and progressive income taxation rates increase. There are also a variety of factors that could keep the savings-income ratio of the L group constant, and this constant ratio, combined with retardation in the rate of growth of total income, could result in a downward turn of the long-term savings-income proportion. While the comments above are far short of an explanation of the trends in the aggregate personal savings-income proportion, they do point to and emphasize the directions in which the explanatory hypotheses might be found and the fields in which further data could be mobilized for specifying and testing them.

In the present connection, an additional factor should be noted. The preceding discussion suggested that there is no firm ground for expecting a secular rise in the proportion of personal savings to in-

come, and that in fact some factors would make for a downward trend in this proportion. However, it must be remembered that we are discussing money savings here, whereas countrywide net capital formation proportions, even in current prices, reflect real processes. It is quite possible for the money savings-income proportion for all individuals and even for all corporations to rise, while the countrywide net capital formation proportion declines, because governments may absorb savings for uses that are not additions to capital stock. This is, in fact, what happened during World War II and in some of the postwar years when military expenditures were unusually large.

This points to an additional factor that in recent decades contributed to a downward trend in the net capital formation proportion—a factor that comes from the uses side, rather than from the savings side, although technically it can be expressed as a decline in the contribution of government savings. There is no need to stress the possible weight of this factor in the present and foreseeable future, considering the major shifts that have occurred in international relations and the greater burdens that governments have had to assume to preserve the security of their countries.

8. The comments so far have borne directly upon the net capital formation levels and trends, viewing the levels as savings proportions of net national product and linking both levels and trends with the factors that determined levels of and trends in personal savings-income ratios. We conclude with a brief outline of the relations between the net capital and gross capital proportions or—what amounts to the same thing—the relations between net capital formation and capital consumption.

In the simplest model, which is adequate for our purposes, capital consumption is a straight-line function of past capital formation, and it is at any given time equal to some fraction of the gross value of capital stock, net of retirements. Given the life span of capital equipment, the ratio of depreciable capital (fixed durable) to nondepreciable (inventories and foreign claims), and the past rate of growth of net capital formation, it is possible to derive capital consumption and hence gross capital formation.

To illustrate: assume that, in the past, net fixed (subject to depreciation) capital formation and the useful life of capital equipment remained constant. Capital consumption would then equal net fixed capital formation, and in fact retirements would equal total capital consumption. For under these conditions, the sum of the fractions

representing current depreciation can be shown to equal one-half the constant annual gross fixed capital formation, or a full year's net fixed capital additions. In this case, net fixed capital formation would be 50 per cent of gross fixed capital formation; and the size of the proportion of gross fixed capital formation to gross national product would be a direct function of net fixed capital formation. Thus, if the latter is 15 and net national product 100, then the gross fixed capital formation proportion would be 30 divided by 115, or roughly 26 per cent.

The illustration can be modified to allow for the growth of net fixed capital formation at a certain percentage rate. With such growth, the earlier levels of capital accumulation, which affect current depreciation, are below those of current net additions; fixed capital stock gross of depreciation and net of retirements, the base that determines depreciation charges, will not be twice net fixed capital stock but somewhat less; capital consumption charges, instead of being equal to net fixed capital formation, will be smaller; and net fixed capital formation will be more than 50 per cent of gross. In general, the higher the rate of growth of net fixed capital formation and the longer the period of life from entry into use to retirement, the lower the ratio of capital consumption to net fixed capital formation, the higher the ratio of the latter to gross fixed capital formation, and the smaller the relative excess of the gross fixed capital formation proportion over the net. The lower the rate of growth of net fixed capital formation and the shorter the life of capital goods, the higher the ratio of capital consumption to current net fixed capital formation, the lower the ratio of the latter to gross fixed capital formation, and the greater the relative excess of the gross fixed capital formation proportion over the net.[13]

This simple model can serve as an outline for explaining both the levels of and the long-term trends in the capital consumption and

[13] For an algebraic analysis of these relations see Appendix B of my paper, "International Differences in Capital Formation and Financing," in *Capital Formation and Economic Growth,* pp. 76–81. The analysis there is in terms of gross national product and the gross capital formation proportion, but can be restated in terms of rates of growth of net national product and assumed constancy of the net capital formation proportion.

The formulation in the text is limited to depreciable capital. Total capital also includes inventories and claims against foreign countries, neither of which is subject to depreciation. Hence the relations indicated in the text apply to gross and net *total* capital formation only if the trends in the shares of the nondepreciable components are of limited magnitude and do not offset the effects of retardation in the rate of growth of fixed—depreciable—capital formation.

gross capital formation proportions, given the levels of and trends in the net capital formation share in net national product. Additional data are needed on the period of useful life of durable capital goods subject to depreciation, the method of apportioning depreciation over time (whether along a straight line or by some curve), and the proportion of total capital subject to depreciation. Such additional data are, to be sure, reflections of a variety of factors: the rapidity of obsolescence induced by technological progress and changes in taste (the latter being to some extent a function of the former); and the factors that determine the share in total capital of fixed durable assets, and the shares of inventories and of claims against foreign countries. Some light may be shed on these factors in the next chapter when we consider the distribution of total capital formation by type of capital good. For the present it is sufficient to indicate the identity of the empirical coefficients and the factors they represent, in passing from the net capital formation proportion to the gross.

The bearing upon long-term trends is also clear. In particular, if as suggested above, the net capital formation proportion in the long run tends to be constant at best, while there is retardation in the rate of growth of net national product, it follows that the rate of growth of net capital formation must decline. And indeed we found such retardation in discussing the long-term movement of net capital formation shown in Table 2. Given such retardation, it follows from the simple model above—which assumes constancy of useful life of durable capital and of the proportion of total capital subject to depreciation—that the proportion of capital consumption to net capital formation is bound to show an upward trend; the proportion of net capital formation to gross capital formation, a declining trend; and the gross capital formation proportion, less of a declining trend than the net capital formation proportion and, if the latter proportion is declining, the gross capital formation proportion may fail to show a decline. Thus, the various lines of connection outlined above do in fact promise an explanation of the results in Tables 8 and 9 insofar as they reveal a long-term decline in the net capital formation proportion coincident with rough stability in the gross capital formation proportion.

Savings and Capital Formation

The discussion in the two preceding sections elaborates our view that the explanation of the levels of and trends in capital formation in

this country is to be sought in the saving process—in the factors that govern the supply of savings rather than the demand for capital funds. It is in the economic and social constraints on the savings contribution of governments and of private corporations, and in the factors that govern the consumption and savings patterns of individuals—the main source of savings—that we may find the basis for a theory that would cogently account for the levels of and trends in at least the *proportion* of capital formation to national product. This would leave the explanation incomplete in that we would still have to account for the levels of national product itself and its trends. But even so, a valid explanation of the capital formation proportion would link the latter closely with the basic processes of economic growth. It would also permit, given some basis for projection or assumption of future trends in national product, an estimation of the probable course of capital formation.

The suggested basic importance of the saving process tempts one to argue that it was the supply of savings that limited capital formation in the past, and that it was not limited by demand for capital created by technological change and investment opportunities. But no such inference can be drawn from our discussion and, for reasons set forth below, no firm inference can really be drawn as to whether it was the supply or demand side that limited capital formation in the past.

To begin with, the explanatory hypotheses above, as indicated repeatedly, did not, and in the present state of analysis cannot, yield specific coefficients. We did not and could not demonstrate that the economic and social conditions under which governments and private corporations operate make it impossible for them to contribute savings of more than 1 and 3 per cent, respectively, of net national product. We did not and could not demonstrate that the factors governing saving by individuals make it impossible or at least exceedingly difficult for them to contribute savings that, in the long run, amount to more than 10 to 12 per cent of net national product. And since it was not feasible to demonstrate that the factors on the supply-of-savings side could not have permitted significantly higher net capital formation proportions, or even significantly different trends, it is possible that the levels and trends that were in fact attained were lower than the savings potential alone could have generated. It is possible also that reduction to levels below the savings potential was produced by some constraining factors on the demand side.

An even more important qualification of our results is that the

whole discussion so far has dealt with the demand for savings and supply of savings separately; and the reasoning has been in terms of demand, as suggested by capital-output ratios, and of supply, as suggested by capital formation proportions. But the actual capital formation proportions and capital-output ratios cannot be fully explained by factors that deal with *ex ante* demand by users of savings and *ex ante* supply by the savers. Savings are generated by individuals or corporations in specific forms and offered for use only on certain conditions—yield, security, duration of loan, and so forth. There may be demand for these funds, but from sources and on conditions that do not match those of the offer. It is the basic function of financial intermediaries to deal with this problem of matching the demand and supply of savings; and the actually observed capital formation volumes are not equal either to *ex ante* demand or to *ex ante* supply, but to some balancing of the two. We have yet to consider the mechanism for such balancing.

Once we introduce the financial intermediaries, defined most broadly as the institutional mechanism for bringing together supply of and demand for savings, and set the basic lines of the money and credit system as a framework within which such meshing can effectively and continuously occur, two major groups of questions arise. The first is suggested by the credit-creating powers of some financial intermediaries, and by the money policy power of governments and of those agencies to which such power may be delegated. In the long run, could not the creation of credit or attempts at financing through issuance of new money be the dominant factor in setting the capital formation proportion in the country? Assume, as suggested above, that factors that determine *voluntary* savings ratios by private economic agencies and even by governments limit the proportion of product that can be devoted to capital formation. Could not credit creation or money inflation be used to force diversion of larger proportions to capital users? The answer to this question would lie in examination of the limits to such "forced" saving set by the reaction of voluntary saving. Such limits can be clearly seen if we assume that credit creation or financing with new money will raise prices (or keep them constant, whereas they might otherwise decline). Under such conditions, the units whose economic power has been reduced by the rise in prices (or by their failure to decline) may react by continuing to consume as much as before, and hence reduce their actual voluntary savings below the level that could otherwise have been expected. If this happens, the

total volume of savings actually realized may not be any larger than it would have been without credit creation or new money issue. Indeed, under certain circumstances the effort to accelerate saving by excessive credit creation or new money issues may have the opposite effect, if, for example, it undermines the faith of the would-be savers in the stability of purchasing power of the money claims that embody their savings. Under different conditions, a controlled development of the credit creating power of financial intermediaries, or the intelligent pursuit of an active money policy by the government, may result in a net increase in countrywide savings and the capital formation proportions—over and above what they might otherwise have been.

The questions just touched upon relate to the long-run effects of countrywide savings and the capital formation proportions. The second group of questions is connected with the short-run effects. We have discussed the processes in their long-term aspects because our interest is in long-term trends. But in reality everything takes place in the short run—from day to day—even though long-term considerations play an important part. Yet when we deal with the short-term aspects of economic life we may, and usually do, find that in the rather complex flow of savings into investment, the meshing of available savings with the demand for them is not simple and automatic. Granted that in the long run a country's economic institutions, particularly its financial intermediaries, are generally capable of resolving discrepancies in the conditions of supply of savings and of demand for capital funds. But such adjustments take time. At any one moment the offered supply of savings can exceed the real demand for them. In this sense, limitations on capital formation cannot lie entirely on the supply-of-savings side.

Note that this problem of short-term adjustment is, paradoxically, in itself a long-term problem. In any economy, particularly a rapidly growing one, there are ever-present shifts among groups in the distribution of income and within groups in the structure of their consumption and savings. The supply of savings is, therefore, flowing from ever-changing sources for ever-changing needs under ever-changing conditions; and the demand of would-be users for savings is subject to an equally varied and continuously changing set of circumstances. It is unlikely that the adjustments, assumed to take place eventually and thus resolve the failure of conditions of supply of and demand for savings to mesh, can ever catch up with these changes that continually create new maladjustments. One can, therefore, en-

visage actual capital formation as a process that continuously, in the long run, unfolds at levels below those that could be attained with the available supply of savings, because of the ever-present disparities in conditions of supply and demand. This view, in turn, has other implications, for capital formation is itself a tool of economic growth, and any shortfall in it may reduce the rate of growth of national product and thus affect the savings potential at the next stage. (We point out, in passing, that it is evident from the above that the capacity of the economic and social institutions to adapt themselves to the continuous adjustment problems of a growing society—the capacity for social invention—is a key to economic growth.)

While granting that the pressures are on both the supply and the demand side, and that the ways in which the mechanisms connecting them have affected the actual processes in economic life, we must also recognize that there is unfortunately no way of measuring the effects of these mechanisms. Available data give us no inkling of the extent to which the savings proportion in this country has been affected by the credit-creating power of the banks or by the money policy followed by the government. The preceding discussion, which stresses the high consumption propensity in the American economy, thereby suggests narrow limits upon the capacity of our credit and money system to effectuate a *net* rise in the savings proportion. This is a crude impression, however, and we are in no position to push this line of analysis further. Nor can we deny that one characteristic of the short-term but continuously present problems of balancing supply of savings and demand for savings is the extreme difficulty of measuring their quantitative effect on capital formation. We do not know how to establish, with reasonable firmness, the magnitude of the savings potential or, alternatively, the reduction effects of the imbalance of conditions of supply and demand. Measures such as we have are inadequate even for gauging the overt processes actually taking place. It would be oversanguine to expect that, without a long period of experimentation and testing, we could secure any measures of *potentials,* or of the effects of disparities between the supply that is being—or would be—offered under varying conditions, and the demand under matching conditions.

With these considerations in mind, all we can say is that our earlier discussion leaves us with the impression that it is the long-run factors on the supply-of-savings side that limit the potential levels and affect the potential trends of the capital formation proportions, even given

the mechanisms of credit creation and money-issue financing; and that the limiting influence of the long-run factors on the demand or capital-use side seems less important. The impression is strengthened by the realization of the rapid increase, at least since the second half of the nineteenth century, in technological knowledge—the host of scientific discoveries, practical inventions, and production improvements—all of which have meant, in the long run, a high potential demand for capital. But this is, nonetheless, no more than an impression, and bears upon the potentials alone. The actual levels of the capital formation proportions are affected by continuous problems of short-term and long-term adjustment, in which, to repeat a famous analogy, demand and supply are like the two blades of a pair of scissors, and it is only in their combination that the explanation lies.

The impression of the dominance of long-term forces on the supply-of-savings side in setting limits to potential capital formation proportions is not, and cannot be, dispelled by consideration of interest rates. It is true that in the long run even riskless interest rates have declined; and one could presumably argue that such a decline precludes the claim that the factors on the supply side limit the level of capital formation. Yet the relevance of trends in interest rates to the question under discussion is only apparent. It is not just that these rates apply only to the part of the savings flow that takes the form of external funds seeking placement. Far more important, like all prices, they measure only the *relative* pressures of demand upon supply. The long-term decline in interest rates, whether in current or constant prices, means simply that the shortage of supply of savings relative to investment opportunities has become less acute. Or to put it differently: with the economic growth of the country and the increased supply of goods per capita, would-be savers give a relatively lower preference to present supply than to future supply. They are therefore willing to discount the future at a lower rate, whereas a comparable rise in investment opportunities over a period of the same duration has not occurred. Thus, if the discount to be applied to a future twenty years hence is reduced on the supply-of-savings side (because of greater availability of goods for distribution between the present and the future), and if investment opportunities over the same time horizon do not rise in the same proportion, twenty-year term interest rates will decline. But the limiting pressure of the supply of savings is still there. The greater promise of a cogent explanation of intertemporal and international differences in the levels of and trends in capital formation proportions

still lies, for reasons suggested in our earlier discussion, in the factors that determine the savings patterns of the country's population.

These comments should explain our earlier allusion to the impossibility, in the present state of knowledge, of providing a testable answer to the question whether in the past it was the supply of savings or the demand for capital funds that limited the levels of the actual capital formation proportions and determined their trends. We can have no more than impressions of the potentials on both sides, and we cannot measure the differences between the actual proportions and the potential. We shall return to this and related questions at the end of our analysis, for they are of obvious bearing upon the whole topic of the use of past experience in a prognosis of the future. It was necessarily touched upon here because the implications of this preliminary discussion are important in the more detailed analysis that follows.

It should be clear both from this preliminary answer and from much of the explanatory discussion preceding it that the forces determining the levels of capital formation and its trends are part of a complex that involves the full spectrum of demographic, economic, and social factors, which must be viewed in its entirety in considering the growth of the economy. It cannot be otherwise, since capital formation is an integral part of national product, affected by it and affecting it. Yet, if only because of the variety of the forces involved and the complexity of their interrelations, no simple scheme that would yield determinate and unequivocal answers is possible. The explanatory hypotheses outlined—although they are carried further perhaps than has been customary in economic literature—could just as easily have yielded answers different from those indicated by the statistical measures of past processes in this country. By using somewhat different assumptions and coefficients, we could have derived higher or lower levels of capital formation proportions, rising rather than constant trends in gross capital formation proportions, and constant rather than declining trends in net capital formation proportions. All we know at present is the directions in which further study should proceed—and it may be that more signposts are needed to lead us to the precise answers we are seeking.

Under these conditions, the channeling of analytical effort toward a close examination of the historical record is of the utmost importance. Such examination should help us avoid preliminary—and, by the nature of the case, dogmatic—hunches. It should compel us to scrutinize the more detailed parts and their interrelations as they can be ob-

served in reality, so that the hypothetical links—which must remain hypothetical at least temporarily—are forged into a chain in which some other links are strengthened by the reasonably reliable records of what in fact has happened. What we shall be searching for in the chapters that follow is more of these sound links, to make sure that any explanation of the forces that determined capital formation in the past will be governed by more knowledge of the changing relative weights of types of capital, of categories of users, of sources and forms of financing.